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APOLLO PROGRAM

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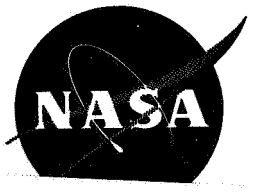
APOLLO LOGISTICS REQUIREMENTS PLAN



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PREFACE

This document has been developed to meet the urgent need for an integrated Logistics support system for the Apollo Program. The Plan identifies the key Logistics elements necessary for timely, effective and economical support, and provides recommended methods for their accomplishment. Part I is a condensed explanation of the Logistics management process for use in discharging our Logistics responsibilities. Part II is the detailed description of this management process, which assures the timely identification and integration of all Logistics resources and services to be provided. In recognition of the fact that we are at the mid-point of the Program and that certain Logistics support actions have already been implemented, this Plan is to be used as the standard against which NASA and contractor Logistics support activities are to be evaluated and improved to provide optimum support for the Apollo Program.

SAMUEL C. PHILLIPS
Major General, USAF
Director, Apollo Program

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APOLLO PROGRAM LOGISTICS REQUIREMENTS PLAN
TABLE OF CONTENTS

PART I

SECTION

1.0 APOLLO PROGRAM LOGISTICS REQUIREMENTS PLAN

2.0 APPLICABILITY AND SCOPE

3.0 FUNCTION

4.0 OBJECTIVE

5.0 POLICY

6.0 APOLLO PROGRAM LOGISTICS REQUIREMENTS MANAGEMENT

- 6. 1 Logistics Baselines Derivation
- 6. 2 Maintenance Requirements Analysis
- 6. 3 Logistics Support Integration
- 6. 4 Maintenance Ground Equipment (MGE) Provisioning
- 6. 5 Spares Provisioning
- 6. 6 Apollo Program Supply Support
- 6. 7 Operations and Maintenance Instructions
- 6. 8 Personnel Training
- 6. 9 Transportation
- 6.10 Propellants and Pressurants

7.0 RESPONSIBILITIES AND AUTHORITIES

8.0 IMPLEMENTATION

PART II

1.0 LOGISTICS BASELINES DERIVATION

2.0 MAINTENANCE REQUIREMENTS ANALYSIS

3.0 LOGISTICS SUPPORT INTEGRATION

4.0 APOLLO PROGRAM SPARES PROVISIONING

5.0 APOLLO PROGRAM SUPPLY SUPPORT

6.0 OPERATIONS AND MAINTENANCE INSTRUCTIONS

7.0 APOLLO PROGRAM TRAINING REQUIREMENTS

8.0 APOLLO PROGRAM TRANSPORTATION SYSTEM REQUIREMENTS

9.0 APOLLO PROGRAM PROPELLANTS AND PRESSURANTS REQUIREMENTS

APPENDIX (A) GLOSSARY OF TERMS

APPENDIX (B) ABBREVIATIONS

APPENDIX (C) PERSONNEL TYPE POSITION DESCRIPTIONS

APPENDIX (D) PERCEPTUAL, JUDGMENTAL, AND MOTOR SKILL CODES

APPENDIX (E) PROGRAM ELEMENT NUMBERING SYSTEM

APPENDIX (F) LISTING OF THE NOUN NAME OF COMPONENT PARTS AND THE CORRESPONDING LETTER CODE

APPENDIX (G) END ITEM LOGISTICS REQUIREMENTS SUMMARY

LIST OF FIGURES

Figure No.

1.0-1	Logistics Baselines Derivation and Related Documentation
1.1-1	Sample AVE Activities Flow Diagram
1.1-2	Sample AVE Activities Flow Diagram Sheet
1.1-3	Sample AVE Operations Flow Sheet
1.1-4	Completed Sample AVE Operations Flow Sheet (Sheets 1--5)
1.2-1	Sample Requirements Analysis Sheet
1.3-1	Sample Trade Study Comparison Sheet
1.4-1	Sample Design Criteria Sheet (Sheets 1--2)
1.4-2	Sample Standard Equipment Requirements Sheet
1.5-1	Sample Timed Flow Sheet
2.0-1	Maintenance Activities Loop Relationship to AVE Operations Flow
2.0-2	Maintenance Requirements Analysis Functions and Related Documentation
2.1-1	Sample Maintenance Activities Analysis Sheet
2.1-2	Sample Maintenance Activities Analysis Sheet
2.1-2	Completed Sample Maintenance Activities Analysis Sheet (Sheets 1--3)
2.2-1	Sample Requirements Analysis Sheet
2.2-1	Completed Sample Requirements Analysis Sheet (Sheets 1--8)
2.3-1	Completed Sample Trade Study Comparison Sheet (Sheets 1--4)
2.4-1	Completed Sample Design Criteria Sheet (Sheets 1--2)
2.4-2	Completed Sample Standard Equipment Requirements Sheet
2.5-1	Completed Sample Timed Flow Analysis (Sheets 1--8)
3.0-1	An Overview of the Logistics Support Integration System
3.2-1	Sample Scheduled Activities Logistics Loading (Sheet 1)
	Sample Unscheduled Activities Logistics Loading (Sheet 2)
	Sample Live Logistics Loading (Sheet 3)
	Sample Maintenance Instructions Sheet (Sheet 4)
	Sample Reliability Information Summary (Sheet 5)
	Sample Spares Information Summary (Sheet 6)
6.4-1	Sample Instruction Requirement Form
6.4-2	Sample Instruction Requirement Form (Sheets 1--2)
6.4-3	Sample Instruction Requirement Form (Sheets 1--3)
6.4-4	Sample Instruction Requirement Form (Sheets 1--2)

LIST OF FIGURES (Cont.)

Figure No.

7.1-1	Illustrative Sample Personnel Training Requirements Analysis Summary
7.2.1-1	Illustrative Sample Course Description
7.2.1-2	Illustrative Sample Trainer Design Criteria
7.2.1-3	Illustrative Sample Trainer Utilization
7.2.1-4	Illustrative Sample Government Furnished Training Requirements
8.1.5-1	Characteristics of Apollo Propellants Pressurants Relating to Hazards in Handling and Transportation
9.12-1	Specific Requirements For the Handling and Transportation of Apollo Propellants and Pressurants (Sheets 1--2)
Appendix E	
E-1	Illustrative Purposes Only (Sheets 1--3)

APOLLO PROGRAM

LOGISTICS REQUIREMENTS PLAN

1.0 APOLLO PROGRAM LOGISTICS REQUIREMENTS PLAN

This is the Apollo Program Office Management Plan which establishes the Apollo Program Logistics Requirements Plan, its applicability, scope, function, objective, and delineates the policies, concepts, and systems analyses approach governing the means by which the Apollo Program's logistics requirements are to be identified, integrated, and satisfied. The proper implementation of this plan will assure that the logistics plans and actions of the numerous NASA and contractor organizations engaged in the Apollo Program are properly integrated and directed towards common program goals.

2.0 APPLICABILITY AND SCOPE

The provisions of this document apply to all NASA OMSF organizations participating in the Apollo Program and its scope includes all Apollo Program activities.

3.0 FUNCTION

The function of the Apollo Program Logistics Requirements Plan is to establish the requirements for identifying, acquiring, providing, applying, maintaining, and managing the human and materiel resources used in accomplishing the program's logistics functions. These functions are listed below.

a. Maintain and repair Apollo Program aerospace vehicle equipment (AVE) at Program Test Sites and KSC.

b. Maintain, repair, and refurbish Apollo Program aerospace ground equipment (AGE) and Mission Support Real Property (MSRP) at Program Test Sites and KSC.

c. Provide operator instructions and training for Apollo Program AGE operation at test sites and KSC.

3.0 (Cont.)

d. Assure the adequacy of the logistics support plans and capabilities being provided for the Apollo Program by non-OMSF organizations.

e. Inter-site transportation of Apollo Program personnel, delicate and/or outsized items (e.g., launch vehicle stages, spacecraft, stage engines, etc.) which require program unique transportation equipment and/or services.

f. Establishment of rapid response transportation capabilities at predetermined geographical locations permitting expedited delivery of program items and/or personnel to KSC on a demand-call basis when they are urgently required to correct pre-launch sequence and/or launch operation problems which would cause program schedule slippage.

g. Supply all NASA and contractor Apollo Program propellant and pressurant requirements.

4.0 OBJECTIVE

The objective of the Apollo Program Logistics Requirements Plan is the establishment of an integrated system of NASA and contractor Apollo Program logistics plans and actions which accomplish the program's logistics functions in a manner and timeframe which does not cause program schedule slippage, personnel injury, equipment damage or degradation and which also results in the accomplishment of the foregoing in a manner which contributes to the realization of over-all program goals at the lowest practical total cost consistent with program schedule requirements.

5.0 POLICY

5.1 All Apollo Program logistics plans and actions shall be in accordance with the provisions of this Plan.

5.2 Any noted conflict between the provisions of this document and other Apollo Program Office documents are to be brought to the immediate attention of Apollo Program Logistics Office (MAP-3)

5.2 (Cont.)

where such conflicts will be resolved on an individual basis.

5.3 All Apollo Program logistics plans and actions shall be compatible with OMSF Apollo Program launch mission objectives and schedules.

5.4 Systematic review and evaluation procedures will be established to compare the logistics materiel requirements of the Apollo Program against available resources (i.e., MIL-standard and commercial specifications and products, declared Government surplus, all NASA programs' specifications, supplies, facilities, services, equipment, instructions, manuals, training programs and equipment, etc.) and those available resources which satisfy or which can be modified to satisfy the Apollo Program's technical and schedule requirements will be applied when economically advantageous to the Government.

5.5 Apollo Program logistics support actions and functions which are to be accomplished by a contractor will be covered by separate contract line items with definitive work statements and/or exhibits describing each logistics obligation, its associated funds coverage and required performance parameters in precise terms which will permit the contracting NASA organization to accurately measure the degree of contractor performance during and after contract execution.

5.6 Incentive type contracts will be used to cover contractor performed Apollo Program logistics support actions and functions in all cases where their use should prove advantageous to the Government.

6.0 APOLLO PROGRAM LOGISTICS REQUIREMENTS MANAGEMENT

Section 6.0 provides a condensed explanation of the management process to be used by all NASA organizations in discharging their assigned Apollo Program logistics responsibilities. The detailed description of this management process is contained in Part II of this Plan. This management process assures the timely identification of all the logistics resources and services which must be provided to support the Apollo Program and assures that these

6.0 (Cont.)

requirements will be provided, distributed, and applied in a manner which satisfies the operating program's requirements in the most effective and economical manner. A single program element numbering system will be used to identify logistics resources for management accounting. Appendix E provides a synopsis of an illustrative example of a program element numbering system which could be developed for Apollo Program use.

6.1 Logistics Baselines Derivation

Apollo Program logistics baselines will be systematically generated to delineate all of the operating program's required resources and functions for which logistics support must be provided to assure the attainment of program objectives. Each logistics baseline will include all of its associated program's operational activities required at and between program test sites, KSC, and mission support areas. The basic steps which will be used to generate this required logistics baseline are outlined below and detailed in Part II of this Plan.

a. Perform an AVE Flow Analysis which provides the series-parallel sequenced success path flow diagrams of all the activities and operations required to assemble and checkout, test, handle, transport, and launch program AVE and to provide or support spacecraft flight mission control, guidance, navigation, tracking, telemetry, communications, and recovery.

b. Perform an AVE Operations Flow Requirements Analysis to determine and document the specific technical specifications requirements and personnel tasks required for program OGE, facilities, MSRP, consumables and operations personnel to satisfy the sequenced AVE activities and operations of (a) above. Alternative approaches for satisfying these requirements are to be developed and evaluated by systematic trade studies to select the one which best satisfies over-all program requirements (performance quality and reliability, environment, maintainability, availability, schedules, etc.).

6.1 (Cont.)

The selected approach will be expressed in terms of the technical specification requirements for OGE, facilities, and MSRP, operations personnel skills and skill codes, and required personnel tasks. In performing the trade study evaluations, defined program assets (OGE, facilities, MSRP, etc.) will be matched against the specification requirements. Those which satisfy the requirements are to be utilized and those which do not will, where practical and economically advantageous, be modified to meet the specifications when this can be accomplished within program schedule and loading constraints.

c. Using the selected means of (b) above, perform an AVE Operations Timed Flow Analysis to assign the AVE and OGE operating times and personnel task times required to perform each AVE flow activity and operation of (a) above. This time information is to be portrayed in series-parallel bar graph form.

The logistics baseline will identify the specific detailed technical requirements for program OGE, facilities, operations personnel, equipment and personnel functional characteristics, equipment operating times, personnel task times, and the inherent status monitoring and fault isolation capabilities of the system.

6.2 Maintenance Requirements Analysis

The logistics baseline data generated in accordance with the provisions of 6.1 will be used to perform a Maintenance Requirements Analysis. This analysis will identify all of the maintenance activities necessary to provide AVE, AGE, and MSRP with its required logistics support and will provide the specifications for the specific MGE, facilities, personnel, spares, and consumables which will be required to effectively and economically perform these required maintenance activities. The basic steps which will be used to perform the maintenance requirements analysis are outlined below and detailed in Part II of this Plan.

6.2 (Cont.)

a. Using the logistics baseline information, perform a Maintenance Activities Analysis to identify all of the specific maintenance activities (e.g., localize failure, demate, remove and replace, repair, mate, checkout repair, etc.) necessary to satisfy the logistics support requirements of the program AVE and OGE. This analysis will determine each identified maintenance activity's maintenance type (scheduled or unscheduled), level, location and probable frequency.

b. Perform a Maintenance Activities Requirements Analysis to determine and document the specific technical requirements and personnel tasks required of program MGE, facilities, MSRP and personnel to satisfy the maintenance activity requirements. The maintenance activities and requirements analyses will also be applied to program MGE to determine the logistics resources to support that MGE. Alternative approaches for satisfying these activity requirements are to be developed and evaluated by systematic trade studies to select the one which best satisfies over-all program requirements. The selected approach will be expressed in terms of its required technical specifications for MGE, MSRP, facilities, spares, personnel skills and skill codes, and the required personnel tasks. In performing the trade study evaluations, defined program assets will be matched against the specified requirements. Those which satisfy the requirements are to be utilized and those which do not will, where practical and economically advantageous, be modified to meet the specifications when this can be accomplished within program schedule and loading constraints.

c. Using the selected approach of (b) above, perform a Maintenance Timed Flow Analysis to assign the AVE, OGE, and MGE operating times and their associated personnel task times as required to perform each of the maintenance activities of (a) above. This time information is to be portrayed in series-parallel bar graph form.

6.2 (Cont.)

d. Logistics requirements summary information, derived from the maintenance requirements analysis, will be prepared for each contract end item to be located at a particular site. This summary information will include the functional, physical, and use description of the end item in its intended operating environment and the logistics elements necessary to support the end item's scheduled and unscheduled maintenance in terms of:

(1) the required maintenance activities, their level and location

(2) the spares and consumables required to perform these activities

(3) the quantity of personnel (and their skill code) required to perform these activities

(4) the MGE and facilities required to perform the activities in terms of their design criteria

(5) the required maintenance instructions by type and projected use

Recommendations for procurement of new logistics resources, utilization of existing resources, or modification of an existing resource to satisfy the contract end items' logistic support will be contained in the summary.

6.3 Logistics Support Integration

The logistics baseline and maintenance requirements analysis techniques called for in 6.1 and 6.2 provide for the identification of all the material and human resources and services necessary to provide logistics support for Apollo Program AVE, AGE and facilities. The end item oriented logistics element requirements arrived at by these techniques must be summarized in terms of their associated system requirements for these elements and placed in balance with each program site's time phased requirements for logistics support. This site oriented logistics requirements

6.3 (Cont.)

integration process is essential to assure the establishment of site logistics systems capable of responding to the time phased site demands for logistics support in a timely, effective and economical manner. The site logistics integration process to be provided must have the inherent capability to rapidly and economically provide modified and integrated site logistics plans which maintain consonance between the logistics capabilities provided and program requirements changes due to such factors as mission or schedule changes, resource shortages, design changes, organizational responsibility realignments, etc. The text which follows provides an abbreviated description of the methods which are to be used to accomplish these logistics management system requirements.

6.3.1 Site logistics requirements summing and integration covering program AVE and OGE will be provided by correlating the logistics baseline with the maintenance requirements analyses. This will be accomplished by inserting the maintenance activities time based flow into the AVE operations timed flow on a probability of occurrence basis. The resultant integrated time flow will be used to sum the logistics resources and services necessary to operate and maintain the site equipment.

The simulated timed flow will also be exercised by introducing into the AVE flow all scheduled activities on a pre-planned basis and unscheduled maintenance activity loops on a randomly selected occurrence basis. The resultant quantities of logistics resources and services will be matched against the maintenance probability of occurrence quantities to verify the latter's adequacy to support probably maintenance support demands. Quantities will be adjusted accordingly. The integrated timed flow will also be used to program alternative operations and maintenance approaches to improve or correct undesirable operating and maintenance conditions which will cause significant program delays. The corrected integrated AVE time flow will be established as the

6.3.1 (Cont.)

new baseline for which the most advantageous logistics support quantities will be summarized.

6.3.2 The site integrated logistics summary, including its supporting system and end item summaries, will utilize electronic data processing (EDP) data storage and retrieval methods to provide rapid access to the preplanned maintenance activities which have been provided to cover program maintenance requirements that may be called for at any point in the AVE operations timed flow. EDP stored data will contain the flow time reference of the maintenance action, maintenance activities and times required to correct the malfunction or accomplish scheduled maintenance, spares required to support the maintenance action, reference to or display of the operations and maintenance instructions to be used by personnel to accomplish their tasks, personnel required by skill code and quantity, maintenance ground equipment required by program element nomenclature and number, and special services and consumables. Information concerning system or equipment redundancy will also be stored which allows the rapid recall of preplanned unscheduled maintenance activity requirements which provide all of the factors needed for making quick and sound on-the-spot decisions as to whether or not to perform corrective maintenance for malfunctions that occur at particular points in the AVE operations timed flow cycle. The EDP data system will provide the capability, at all points in the AVE operations flow, to rapidly compare the maintenance activities and time required to repair malfunctions with the remaining operations sequence requirements and the time remaining to achieve successful test and/or mission accomplishment.

6.3.3 Utilizing the site integrated logistics summaries, Apollo Program site logistics plans will be developed which include planned actions for recording and reporting logistics resource inventory and allocation, technical engineering personnel required for surveillance and problem resolution, methods for processing and

6.3.3 (Cont.)

tracking system and equipment changes including the resultant modifications in accordance with NPC 500-1, propellants and pressurants management, methods for documentation and machine storage of logistics data and inter-site transportation of contract end items and spares. The site logistics plan will also include a thorough description of the site logistics organization and management system necessary to apply and maintain the above logistics requirements, methods of interface with other operating elements and methods for achieving accurate and current scheduling and status control.

6.4 Maintenance Ground Equipment (MGE) Provisioning

Using the technical specification requirements developed in accordance with the provisions of 6.2, detailed MGE end item specifications shall be prepared in accordance with the contract end item specification provisions of NPC 500-1. In addition, the preliminary MGE design reviews, critical design reviews, first article configuration inspections and testing shall be conducted on MGE in accordance with NPC 500-1 requirements. Changes to the MGE's associated logistics requirements documentation will be made and kept current as MGE design and procurement actions progress.

The logistics summary information to be provided in accordance with the provisions of 6.3 will specify the total quantity of each different MGE item which must be maintained in an operable status at all times at program test sites and KSC to assure adequate logistics support at these locations. Each NASA organization responsible for the adequate provisioning of MGE in support of these locations' activities will assure that his associated contractors establish and document sound and compatible MGE provisioning systems which appropriately use that locations' summary MGE logistics requirements data in arriving at the total number of each MGE item to be provisioned. Each of these NASA

6.4 (Cont.)

organizations shall also exercise appropriate management action to assure that each of its contractors' MGE provisioning systems make correct use of the MGE repair level, location, and repair cycle data supplied by the MGE's maintenance requirements analysis in determining the total quantity of MGE to be acquired. The MGE supply system requirements are contained in 6.6.

Contracting methods used for procuring required MGE shall be in accordance with established NASA procedures covering the acquisition of contract end item equipment.

The Apollo Program Logistics Office organization assigned the responsibility for assuring the appropriateness of all Apollo Program MGE management will assure that the respective NASA Center organizations are provided with any Apollo Program Office counsel required to properly comply with the provisions of 6.4.

6.5 Spares Provisioning

A comprehensive and integrated Apollo Program spares provisioning management system is to be developed and established and made an integral part of the logistics program at each NASA Center requiring program spares to discharge its assigned Apollo Program responsibilities. These systems are to include the documented methods and procedures to be used for providing effective and efficient management and control of the spares provisioning systems employed by program participants to select, quantify, allocate, release, procure, price, preserve, pack, mark, inspect, accept, deliver, replenish, configuration control, and to measure, control, and report spares provisioning requirements and status. These spares provisioning management systems are to be postured and applied in a manner which provides positive assurance that its sponsoring Center's program spares requirements will be satisfied in the most timely and economical manner consistent with program schedule requirements. The material which follows provides an abbreviated description of the major elements which are to be made

6.5 (Cont.)

an integral part of these spares provisioning management systems. The detailed system requirements are described in Section 4.0 of this Plan, Part II.

6.5.1 Each Center is to develop and establish effective and efficient inter-Center liaison and coordination methods which assure that the spares provisioning practices of the Centers' in-house and contractor organizations are integrated and program compatible.

6.5.2 To assure that required program spares provisioning actions are accomplished in consonance with program schedule requirements, the Centers' Apollo Program logistics functions will assure that program participants establish comprehensive spares provisioning action plans covering all of their equipments spares requirements. These action plans are to be required in schedule format portraying the projected milestone dates and time spans associated with each required spares provisioning action (spares selection, quantification, transporation, etc.) necessary to deliver program spares and repair parts to their using locations supply facility in consonance with program schedule requirements. To the degree necessary to maintain their awareness of all spares provisioning action plan slippages or problems which place the Apollo Program schedules in jeopardy or which may result in extra program costs, the Centers' logistics functions will conduct periodic reviews of progress status against these plans and will require their program participants to submit reports on their spares provisioning schedules and funding status, and their six months spares release forecast at not less than 30-day intervals. NASA report recipients will assure the satisfactory resolution of unsatisfactory conditions and will use the reports as one measure of contractor spares performance.

6.5.3 Apollo Program spares provisioning personnel are to work concurrently with their organization's maintenance requirements analysis personnel to jointly select program spares, repair parts,

6.5.3 (Cont.)

and consumables requiring provisioning actions as required to support the maintenance activities for all program equipment and reparable spares at all maintenance levels and locations. Spares selection decisions will be supported by documented trade studies of alternative spares which identify the spare best suited to program requirements. These trade studies are to consider such factors as spares accessibility in the malfunctional equipments and reparables, required maintenance repair times and costs, maintenance action frequency, spares costs availability, equipment reliability impact, personnel and equipment safety, and OGE system versus MGE fault isolation requirements. Program controls are to be established to provide positive assurance that the program's maintenance requirements analyses and spares provisioning plans are in consonance.

6.5.4 NASA Center Apollo Program logistics functions will perform comprehensive reviews of the spares provisioning methods used by their Centers' in-house and contractor organizations to assure that they are technically correct, integrated, and program compatible. These NASA logistics functions will exercise the degree of managerial control over the manner in which these methods are applied to assure they result in the provisioning of the minimum quantity of spares, repair parts, and consumables which are required to provide proper confidence levels of their availability at their needed program maintenance levels and locations in quantities which preclude program schedule slippages and/or extra costs due to their inadequate supply.

6.5.5 Each NASA Center's Apollo Program logistics function is to develop, document, and establish contractually controlled interim spares order release systems to permit selected program contractors to initiate procurement actions for acquiring their required program spares in advance of completing the spares normal provisioning process when and if such interim release actions are

6.5.5 (Cont.)

proven essential to satisfy program spares support need date requirements.

6.5.6 Apollo Program spares whose removal from program equipments and/or assemblies will be required to perform first or second level maintenance actions are to be jointly evaluated by maintenance requirements and spares provisioning analysts to identify those spares whose repair is technically feasible and economically advantageous. These identified spares will be further analyzed to determine their most desirable repair source (i.e., program site location, prime contractor facility or vendor facility). The selected spares repair location will be noted by appropriate coding in the applicable spares provisioning and supply system documentation.

6.5.7 Within the spares provisioning portion of each site's logistics requirements summary described in Section 3.0, Part II, the NASA Center's Apollo Program logistics function is to include a listing of all reparable spares including their repair locations, repair parts and materials and procedures for controlling and recording all maintenance levels' reparable spares. These procedures are to be coordinated with contractors and vendors and approved for use as standard operating procedures.

6.5.8 Procurement procedures and controls are to be established for incremental release and continued updating of priced spares lists, adequate spares provisioning of Apollo Program site activation and operational phases with minimum spares duplication and excesses, provisioning of GFP and GFAE spares requirements to the prime and associate contractors, and spares delivery to the NASA sites while maintaining contractor custody for use, modification and repair. Spares ordering and identification control will be established to prevent separate ordering and stocking of identical items, trace and account for reparable spares and maintain site/system spares allocation compatible with maintenance demand

6.5.8 (Cont.)

locations and levels.

6.5.9 Procured spares inspection and acceptance actions are to be compatible with the requirements of Apollo Program Documents NPC 200-2 and NPC 500-1. Preservation, packaging and marking of procured spares will be in consonance with the provisions of NPC 500-1 as commensurate with shipment destination, transportation mode, storage environment and inspection, shelf life, calibration, etc., requirements.

6.5.10 Effective spares replenishment program controls are to be developed which assure that spares replenishment quantity and order release timing are determined by and in consonance with the most current logistics baseline and logistics requirements summary information and the spares current posture with respect to design, cost, pipeline and repair cycle times and impending changes to configuration and program schedules.

6.6 Apollo Program Supply Support

An Apollo Program supply management system is to be developed, established and made an integral part of the logistics program at each NASA Center assigned program logistics responsibilities. These systems are to encompass the documented systems and procedures to be used to provide effective and efficient program management and control over the methods and time phasing used by the Center's program participants to discharge their assigned program supply system functions (e.g., identification of supply system requirements, inventory control, priority and routine requisitioning, storage, accounting of supply assets, etc.). An abbreviated description of the major elements which are to be made an inherent part of the program's supply management systems follows. Section 5.0 in Part II of this Plan provides a detailed description of these requirements.

6.6.1 Apollo Program supply systems are to be in consonance with the

6.6.1 (Cont.)

supply systems' provisions of the documents referred to below.

a. For equipments and spares to be furnished to program contractors as GFP-GFAE, the following documents will be applied:

(1) NPC-400, Part 13, "Government Industry Property."

(2) NPC-105A, "Property Control Manual."

(3) ASPR Appendix B, "Contractor Management and Control of Government Property."

b. For equipments and spares owned and managed by NASA Centers and sites organizations, the following documents will be applied:

(1) NMI 4020.1, "Survey of Lost, Damaged, Destroyed Property."

(2) NMI 4120.1, "Management of Store Stocks."

(3) NMI 4210.1, "Property Accountability."

6.6.2 Apollo Program supply system management controls will be established and utilized by NASA Center logistics functions covering the supply status of all program participants to maintain Center cognizance of the status of all key program supply action requirements against program schedule needs. Program contractors will be required to submit monthly reports covering all their actual and forecast supply system problems or delinquencies which may adversely affect program schedules and/or costs.

6.6.3 To assure that program supply support requirements are satisfied on a basis consistent with program schedule needs and funding, Center logistics functions will require that comprehensive supply management plans are established and maintained by their program participants covering all their assigned supply system responsibilities. These plans are to be prepared in a format which portrays the time sequencing of required supply system actions, their associated time span and milestone requirements, funding

6.6.3 (Cont.)

posture and the program status relative to these factors.

6.6.4 Center Apollo Program logistics functions will develop and employ effective and efficient means to accomplish inter-Center liaison and coordination which assure that the supply systems of each Center's in-house and contractor organizations are integrated and program compatible.

6.6.5 Center Apollo Program logistics functions will identify, forecast and control their associated program requirements for administrative, warehouse and repair shop space needed to fulfill their logistics obligations at Centers, test sites and KSC. These logistics functions will employ methods assuring that their space requirements are properly integrated and compatible with spare availability at these program locations.

a. Required program supply support services and functions at these locations are to be screened to identify those which can effectively and economically be furnished from a common source to preclude unnecessary duplicate sources being established.

b. Apollo Program contractors will be required to furnish their bulk and standard item requirements to their cognizant logistics function at each of these locations who will establish centralized site supply sources to efficiently furnish the site contractor organizations with these commodities within timeframes consistent with program schedule requirements and in a manner precluding unnecessary work delays due to the lack of these commodities.

6.6.6 Each Apollo contractor is to submit a plan identifying his methods and procedures for integrating and controlling equipments and spare parts in his custody at factory, test sites and KSC. These plans are to include time spans proposed to issue stocks from store rooms and the priority system to be used in obtaining parts in short supply from other sources.

6.6.7 As a part of their inventory management process, Apollo contractors are to establish and maintain inventory levels and reorder points. These are to be closely controlled and time phased to be consistent with probable demand frequency and approved forecasts of program spares support requirements.

6.6.8 The stock room procedures at test sites and KSC under the jurisdiction of contractor are to cover inventory control, receipt, storage and issuance of spares and modification kits. Further, they are to cover recalibration and shelf life replacement scheduled for spares in stock. Daily stock balance and consumption reports are to be made on all supply transactions when parts are received or withdrawn from stock.

6.6.9 Apollo contractor inventory records at Centers, test sites and KSC are to include the level and location of repair for reparable parts. When reparables are shipped from stock rooms to repair sites, accountability is to be transferred from the consignor to the consignee.

6.6.10 A master property accounting and stock record central data bank will be developed and maintained by Apollo Program contractors. This data bank will cover MGE and spare parts. Transactions affecting the stockage position will be recorded on a daily basis.

6.7 Operations and Maintenance Instructions

An Apollo Program operations and maintenance instructions system is to be established and made an integral part of the logistics program at each NASA Center assigned Apollo Program logistics responsibilities. This system is to provide effective control and management of the methods and time phasing used to develop, provide and maintain an integrated system of explicit and easily understood documented instructions which specify the manner in which the program's human and material resources will be applied to accomplish operations and maintenance on the Apollo Program AVE, AGE and

6.7 (Cont.)

facilities at the test sites, KSC and flight mission support and recovery locations.

The instructions will be identified by and utilize information from the logistics baseline (6.1) and maintenance requirements analyses (6.2) and will be in consonance with all safety rules and regulations and the most current design specifications and limitations. The instructions are to provide operations and maintenance personnel with clear and readily understandable procedures for performing equipment operation and maintenance activities and are to be prepared and provided in a manner which assures that, when properly used, the required personnel tasks will be properly consummated within the time frames specified by their associated operations and maintenance timed flow sheets. They will include system and equipment description and parts lists, handling, storage, personnel task, inspection, calibration, operations, and maintenance data. An abbreviated description of the operations and maintenance instructions system requirements follows. Detailed requirements are described in Part II, Section 6.0.

a. Instructions will be prepared covering system and equipment description, system operations and maintenance activities and tasks, equipment operations and maintenance, inspection procedures, spares and spare parts, supply procedures, operating and maintenance checklists and refurbishment procedures. Maximum utilization will be made of existing drawings, illustrations, engineering specifications and procedural data, microfilm reference, calibration and test data.

b. For verification purposes, instructions will be prepared in format and content similar to utility type manuals. Instructions intended for operational use will be of format and content to be developed and agreed upon by the Inter-Center Logistics Working Group. (See Section 8.0.)

6.7 (Cont.)

c. An instructions quality assurance verification and/or audit program will be establisted within each program logistics organization in consonance with NHB 5300.1 to ensure that technical content, format and equipment compatibility requirements are satisfied. The quality assurance program will provide for adequate configuration control and accountability records for the verification of all instructions against the equipment operations and personnel tasks they support. Instructions reviews will be accomplished during preparation and upon completion which place primary emphasis on the technical accuracy and adequacy of the material. Verification of the instructions will be accomplished using test or operational equipment upon which the operations and tasks are performed. Verification will be limited to operations and maintenance critical to mission success and, when practical, will be conducted during regularly scheduled program activities.

d. Distribution and delivery of instructions will be based upon hardware use locations and schedules. A means will be established within each logistics organization to provide instructions scheduling and current status and to maintain accurate and current funding visibility. Each NASA organization will provide a review of instructions schedules, funding and program status to the Apollo Program Office quarterly. Contractors will provide schedule, funding and status reports to their respective NASA Centers every 30 days.

6.8 Personnel Training

An Apollo Program personnel training system is to be established and made an integral part of the logistics program at each NASA Center assigned Apollo Program logistics responsibilities. This system is to provide effective control and management of the methods and time phasing used to identify, develop, provide and

6.8 (Cont.)

maintain an integrated training system for the Apollo Program which will include the training courses and equipment necessary to instruct the operations and maintenance personnel in the equipment and systems functions to be performed in support of the AVE, AGE and facilities at the test locations, KSC and flight mission support and recovery locations.

A training requirements analysis will be conducted for the personnel skills identified by the logistics baseline (6.1) and the maintenance requirements analysis (6.2) output information. The quantities of personnel requiring training will be determined from the logistics summary information described in 6.3. Training development will make maximum use of the operations and maintenance instructions described in 6.7, and will assure that the trained personnel are completely knowledgeable of the use to be made of these instructions at their intended using locations. An abbreviated description of the personnel training system requirements follows. Detailed requirements are described in Part II, Section 7.0.

a. Personnel training requirements analyses will be conducted to identify training required to prepare personnel to operate and maintain all Apollo Program equipment in a manner which will maintain that equipments' performance standards. The analyses will be the means used for identifying the characteristics of training courses and equipment.

b. Equipment, system and program training plans will be established covering required program training courses and equipment. Each plan will include the program area covered by the training, a summary of the personnel requiring training, a definition of the required courses, the training equipment required, training schedules, training interface with other systems/programs, training evaluation methods, personnel certification required and an estimate of the support resources, i.e., administrative, facilities, services

6.8 (Cont.)

from other contractors and NASA, travel, etc.

c. Training will be conducted in accordance with the training plan requirements. Appropriate NASA contracting for training will consider the cross-training aspects between systems and programs and will require a training performance measurement system for evaluation of conducted training. The performance measurement system will be applied by course examination and on-the-job evaluation.

d. Training equipment will be systematically identified in accordance with the personnel training requirements analyses described in (a) above. Training equipment specifications will be developed which clearly specify the purpose and scope of training, definition of training equipment design and layout, training functions to be accomplished, functional equipment description, installation and checkout requirements, supporting data such as documents and instructions, test and acceptance requirements, cost estimates, and development schedules. The design specifications and procurement of training equipment will be in accordance with NPC 500-1 and common to that utilized for design and procurement of all Apollo Program system equipment.

e. Training equipment demonstrations are to be performed to assure the capabilities of the trainer to accomplish its specific training objectives and identify problem areas and deficiencies for correction prior to the start of operational and maintenance training.

f. Training system management controls will be established to assure that all required program training is contractually covered in a nonredundant manner and to monitor training and training equipment to ensure compatibility with Apollo Program equipment and system training requirements, develop

6.8 (Cont.)

schedules which will clearly portray major training milestones and critical training events, maintain training program status to provide early visibility of schedule slippages and monitor expenditures against program funding commitments. Each NASA organization will submit a schedule, status and funding report to the Apollo Program Office quarterly. Reports from the contractors to the NASA organizations will be required at not less than 30-day intervals.

6.9 Transportation

A comprehensive and integrated Apollo Program transportation management system is to be established and made an integral part of the logistics program at each NASA Center which requires this service to execute its assigned responsibilities. This system is to encompass methods and procedures which assure the effective management and control of means used to identify, establish, integrate, acquire and apply the transportation elements necessary for satisfying the requirements of each Center. These management systems are to be postured and applied in a manner which provides positive assurance that the Center's transportation requirements for delivery of end items, propellants, pressurants, materials and personnel are satisfied with transportation resources and services which meet program specifications and master management schedules in the most economic manner consistent with these requirements.

Section 8.0, Part II of this Plan delineates the requirements, both technical and management, necessary to provide priority transportation support, as applicable, to all elements of the Apollo Program. These requirements will be in consonance with all logistics requirements of this Plan and will ensure that program development plans, contracts, specifications, Center transportation plans and other related documents contain appropriate transportation requirements provisions.

6.9 (Cont.)

The transportation technical and management requirements apply to all NASA organizations engaged in the Apollo Program transportation activities and in the preparation of transportation plans for each major program item. Early development of these plans and their maintenance throughout the program, will assure the successful transport movement of Apollo Program elements within required schedules at minimum cost. The factors which must be considered in developing transportation requirements and planning are briefly described as follows:

a. Identification and configuration of each Apollo Program item to be transported.

b. Sequence planning from point of origin to destination is to be in consonance with the logistics baseline, Section 1.0, Part II of this Plan.

c. Mode of transportation equipment utilized and its maintenance requirements are to be in consonance with the logistics baseline and maintenance requirements analyses identified in Sections 1.0 and 2.0, Part II of this Plan.

d. Design and modification of special transportation equipment.

e. Civil construction or route modification for special outsized or overweight items.

f. Schedule of movements.

g. Budgetary requirements.

h. Packing and packaging requirements.

i. Personnel (government or contractor) to accompany Apollo Program items.

j. Materials handling equipment.

k. Other special considerations (i.e., environmental constraints, shock mitigation, vibration, fragility, etc.).

6.9 (Cont.)

1. Review and evaluation of available transportation equipment, services, and facilities of other government agencies for compatibility with Apollo Program requirements.

m. Alternate and/or backup transportation modes for use in the event of failure of the primary transportation mode.

6.10 Propellants and Pressurants

Section 9.0 in Part II of this Plan provides a detailed description of the Apollo Program propellants and pressurants logistics management system requirements. The text which follows provides an abbreviated description of these program requirements.

a. A comprehensive and integrated Apollo Program propellants and pressurants (P & P) management system is to be developed and established and made an integral part of the logistics program at each NASA Center requiring these products to discharge its assigned program responsibilities. This system is to provide methods and procedures which assure the effective management and control of the means used to identify, integrate, acquire and apply the Center's propellants and pressurants for all its program needs (i.e., research and development, test, operations, etc.). These management systems are to be postured and applied in a manner which provides positive assurance that the Center's P & P requirements are satisfied with products and facilities which meet needed quality and capability standards and program need dates in the most economic manner consistent with these requirements.

b. Effective and efficient methods are to be developed and established within each Center's P & P management system for assuring that the respective Center P & P requirements are coordinated and integrated with those of other program Centers.

6.10 (Cont.)

c. Each Center's Apollo Program logistics function will provide long range program propellants and pressurants planning information in the form of systematic forecasting of program propellants and pressurants requirements, periodic resource requirements reviews, and economic studies relating to propellants and pressurants acquisition and accurate funding needs estimates.

d. Each Center's Apollo Program logistics function will provide program P & P acquisition guiderules to assure sound determinations of the mode of propellants and pressurants supply (GFP vs. CFP) to be used. When it is decided to GFP the propellants and pressurants, the P & P Function will acquire the propellants and pressurants from existing Government facilities, supply support systems or by commercial procurement. The Center's program logistics function will provide uniform procedures for propellants and pressurants funding, ordering, inventory management and control.

e. Each Center's Apollo Program logistics function will be responsible for the availability of adequate propellants and pressurants quality specifications. In case of new propellants and pressurants requirements generated by a program technical office or contractor, the cognizant program logistics function will determine the applicability of existing specifications, the necessity for modifying an existing specification, or requirement for writing a new specification. Maximum use will be made of existing specifications, including Federal, Military or other NASA specifications. Each Center's Apollo Program logistics function is to be responsible for writing and maintaining propellants and pressurants specifications pertaining to its Center's equipment requirements.

f. Each Center's Apollo Program logistics function is responsible for determining and publishing "use limits" which define the

6.10 (Cont.)

minimum quality of the propellant and pressurant permissible at a given point in the logistics system. Use limits will allow for the normal change in propellants and pressurants quality with repeated handling.

g. Propellants and pressurants handling procedures will be established by each Center's Apollo Program logistics function to ensure safe and economical handling of these products. Training and safety surveillance programs will be established by the P & P Functions to indoctrinate personnel in the safe handling of propellants and pressurants. In addition, they will monitor their Center's associated propellants and pressurants operations to ensure that safe practices are used at all Apollo Program locations where program equipment and/or personnel are involved in these operations.

h. Each Center's Apollo Program logistics function will conduct reviews of existing propellants and pressurants facilities and make recommendations for correction of any deficiencies in storage, equipment, personnel operations and maintenance procedures and methods of control. For future propellants and pressurants facilities requirements, each Center's program logistics function will specify and provide control criteria which assures that these facilities, when acquired, will be in consonance with the program's propellants and pressurants requirements.

7.0 RESPONSIBILITIES AND AUTHORITIES

Section 7.0 describes the Apollo Program responsibilities and authorities as they pertain to the provisions of this plan.

7.1 Apollo Program Office

The Apollo Program Director has over-all responsibility for Apollo Program logistics management. This responsibility includes:

a. Developing and issuing policies and requirements governing

7.1 (Cont.)

Apollo Program logistics management.

b. Allocating Apollo Program logistics functional responsibilities between participating program Centers.

c. Establishing an Apollo Logistics Management Branch within Apollo Program Control to act as the Program Office focal point for all program logistics matters.

d. Acting as chairman of or designating an Apollo Program Office representative with decision-making authority to chair the Inter-Center Logistics Working Group for this Plan. (See Section 8.0 on Implementation.)

7.2 Chief of Apollo Logistics, Apollo Program Office

The Chief of Apollo Logistics, Apollo Logistics Management Branch has the responsibility for the following:

a. Developing, issuing and maintaining the Apollo Program Logistics Requirements Plan which is the prime document utilized by the Apollo Program Director in implementing and managing program logistics systems.

b. As directed by the Apollo Program Director, chair the Inter-Center Logistics Working Group and provide counsel relative to the management requirements of this Plan and its time phased implementation schedule requirements.

c. Reviewing the Centers' plans and methods for implementing and managing the provisions of this Plan and advising Apollo Program Control relative to these matters.

d. Reviewing and providing Apollo Program Office decisions on any proposed Center changes to the Apollo Program Logistics Requirements Plan.

e. Resolving inter-Center problems relative to the integration of the implementation and management of this Plan.

7.3 NASA Center Apollo Program Managers

Each Center Apollo Program Manager is responsible for the following:

a. Establishing a central focal point within the program office for all his program logistics matters.

b. Providing the logistics management capabilities within the program office to properly execute the requirements of the Apollo Program Logistics Requirements Plan and to provide the managerial direction, authorities and control essential to the office's accomplishment of these requirements in a timely, effective and economical manner.

c. The development, establishment and maintenance of a Center project logistics plan which is in consonance with the Apollo Program Logistics Requirements Plan. These plans are to be submitted to the Apollo Program Director for approval through the Chief of Apollo Logistics prior to the formalization of contractual action to implement same unless otherwise directed by the Apollo Program Director.

d. Developing, establishing and implementing intra-Center and inter-Center liaison and coordination actions which result in his logistics plans and actions being integrated and compatible with the program plans of his Center's other program organizations and those of his counterpart program organizations at other Centers.

e. Providing active representation on this Plan's Inter-Center Logistics Working Group empowered with the authorities necessary to permit the efficient conduct and discharge of the Panel's chartered responsibilities (see Section 8.0).

8.0 IMPLEMENTATION

This Section describes the management process to be used to implement the Apollo Program Logistics Requirements Plan. The time phased actions called for by this process intrinsically provide NASA Centers with the means and managerial latitude necessary to permit the beneficial implementation of this document's provisions in an orderly, timely and coordinated basis which will result in the establishment of integrated logistics systems which assure the accomplishment of the program's required logistics functions at the lowest cost consistent with over-all program mission and schedule requirements.

8.1 Inter-Center Logistics Working Group

NASA Center Apollo Program managers will utilize the Inter-Center Logistics Working Group as the principal means of coordinating their respective implementation plans and actions with those of other Center program elements and are to provide panel participation and guidance assuring the timely and mutually satisfactory integration of Center logistics plans.

8.2 Apollo Program Logistics Plans

The Apollo Program Logistics Requirements Plan will be used to develop and establish all program logistics plans. Center Apollo Program managers are to systematically generate detailed plans which assure that all logistics plans will be in consonance with this document's provisions and methodology unless specific deviation approval is obtained from the Apollo Program Director or the Chief of Apollo Logistics.

8.3 Implementation Deviations

Center Apollo Program offices may use analytical and/or logistics management methods which are different from those specified in this document providing that such methods will accomplish the

8.3 (Cont.)

objectives set forth in this document. The methods and procedures approved by the Center's Apollo Program Manager will provide conclusive assurance that the Apollo Program Logistics Requirements Plan's specified logistics system requirements will be satisfied. This action is essential to assure that all program logistics requirements are identified and satisfied and in a manner and time frame permitting effective integration and control of all program logistics support plans and actions.

8.4 Implementation Schedule

Logistics plans in consonance with the Apollo Program Logistics Requirements Plan will, as a minimum, be established and their proper performance capabilities verified by comprehensive integrated service testing prior to 1 July 1967.

PART II

INDEX FINDER

SECTION	
1.0	LOGISTICS BASELINES DERIVATION
2.0	MAINTENANCE REQUIREMENTS ANALYSIS
3.0	LOGISTICS SUPPORT INTEGRATION
4.0	APOLLO PROGRAM SPARES PROVISIONING
5.0	APOLLO PROGRAM SUPPLY SUPPORT
6.0	OPERATIONS AND MAINTENANCE INSTRUCTIONS
7.0	APOLLO PROGRAM TRAINING REQUIREMENTS
8.0	APOLLO PROGRAM TRANSPORTATION SYSTEM REQUIREMENTS
9.0	APOLLO PROGRAM PROPELLANTS AND PRESSURANTS REQUIREMENTS

1.0 LOGISTICS BASELINES DERIVATION

Apollo Program logistics baselines will be systematically generated to delineate all of the operating program's required resources and functions for which logistics support must be provided to assure the attainment of program objectives. The basic steps which will be used to generate this required logistics baseline are described in detail in this section.

The logistics baseline will be identified by the data developed from analysis of the activities which satisfy the technical requirements of AVE within its operational concept. The tasks to be performed in fulfilling the analysis are as follows:

a. Structure flow diagrams of the AVE requirements in functional terms whose sequential and parallel interactions are clearly defined. The structuring will be performed by an AVE Activities Flow Analysis in accordance with paragraph 1.1.

b. Define the technical requirements which are levied by the AVE functions and apportion those requirements to equipment, facilities, and personnel. Definition will be provided by performing an AVE Operations Flow Requirements Analysis per paragraph 1.2.

c. Conduct studies to systematically consider design and logistics alternatives and select the best approach for accomplishing a function. The Trade Studies will be performed as shown in paragraph 1.3.

d. Define equipment and facility performance requirements in engineering terms to provide the criteria for detail design. Design Criteria and Standard Equipment Requirements sheets will be completed as described in paragraph 1.4.

e. Depict the time base sequential and parallel relationship of the operational functions to determine equipment

1.0 (Cont.)

facilities and personnel utilization time. The AVE Timed Operations Flow will be conducted in a manner similar to that shown in paragraph 1.5.

The logistic baseline derivation and associated documentation are shown in Figure 1.0-1. The documentation sheets to be used with the Requirements Analysis, Trade-Studies, End Item Requirements, and Timed Flow Analysis will be structured to permit their common use in establishing the logistics baselines and for use in performing the maintenance requirements analysis. The methods described herein are based upon this premise. Instructions for completing these documents follow. Sample illustrative copies of completed documents are contained in the appropriate portions of 2.0 (Maintenance Requirements Analysis). A description of the baseline functions and details on preparation of the documentation follows.

1.1 AVE Flow Analyses

AVE Flow Analyses will define all activities and operations which generate inline support system elements, i.e., those elements required to directly support the processing of the Apollo aerospace vehicle equipment. The activities and operations are sequenced in respect to constraints imposed by the Launch Vehicle and Apollo Spacecraft which are of specified design. For purposes of common usage, the terms defined below will be applied to all flow analyses.

a. An <u>activity</u> encompasses gross functional requirements such as assemble, test, or transport and is based on mission concept. <u>Activities</u> are comprised of <u>operations</u>. An <u>operation</u> is the lowest level function which identifies technical requirements for equipment or facilities. <u>Operations</u> are, in turn, composed of the <u>personnel tasks</u> which describe how the equipment or facility identified is utilized by man to satisfy the operation.

1.1 (Cont.)

b. A specified design is a specific configuration of the AVE which will be processed by the flow.

c. Where the installation, assembly and/or checkout of OGE generates additional OGE requirements, a subflow is required based on the specified design of the OGE processed.

As a prerequisite to establishing the flow, the operations concepts and contraints will be defined. These concepts and constraints will define the approach to and criteria for assembly and checkout, test, transport, handling, pre-launch and launch operations, refurbishment operations and flight mission and recovery ground operations from manufacturing through the flight mission.

1.1.1 AVE Activities Flow Diagram

All activities will be functionally oriented to the specified design, i.e., the system element requirements are defined by functions required to process the specified design. The activities shall be numbered in a manner that will consider the parameters of continuity, positive identification, and ease of change. (For example, see Figure 1.1-1.) Provisions shall be made for adding activities at required locations without changing the number sequence. Where activities are extremely gross, a double circle will be used on the main flow diagram to indicate that an additional sheet flow is being used. This is an artificial device used for documentation convenience. (For example, see Figure 1.1-2.) The AVE Operations Flow sheet will be used to break down each activity to the operation level. All operations required to define the equipment requirements to support an activity will be delineated on the applicable Operations Flow sheet and selected to be compatible with the operations concept and any existing system elements. This single characteristic will make the flow, including the Operation Flow

1.1.1 (Cont.)

sheets, independent of support elements design and localize changes when the specified designs are altered. (For a sample Operations Flow sheet, see Figure 1.1-3.) Personnel tasks will not be included in the operations sheet portion of the flow. For example: A "gain access" function will be included if it generates an access platform. If, however, the access can be accomplished as a pure personnel task, it shall not be included. Instructions for the formulation of an operations flow sheet follow:

1.1.2 AVE Operations Flow Sheets

AVE Operations Flow sheets will be used to delineate flow activities to an operations level and simplify flow documentation. Operations Flow sheets are completed as follows:

1.1.2.1 Activity Number (1)

Enter the number assigned on the AVE Activities Flow diagram to identify a specific activity. This number relates an activity on the Activities Flow Diagram to a specific AVE Operations Flow sheet.

1.1.2.2 Activity Title (2)

Enter the identical Activity Title that appears on the activities flow diagram. The Activity Title is a brief descriptive phrase of the operations occurring under an activity number.

1.1.2.3 Operation Sequence (3)

The Operation Sequence is the order in which various operations will be performed. The Operation Sequence considers constraints imposed by the specified design and will be depicted in a series/parallel manner.

1.1.2.4 Operation No. (4)

The Operation No. is a dash number assigned to identify a specific operation. The operation number relates the

1.1.2.4 (Cont.)

operation title with the Operation Sequence.

1.1.2.5 Operation Title (5)

A brief description of the lowest level operation or task which generates support element requirements or equipment will be entered. Each operation title is composed of the following elements:

a. Verb or Verb Phrase - depicting the action of the operation in the first position in the statement of the operation.

b. Subject - following the verb and defining the component or system to which action is applied.

c. Noun Phrase - following the subject identifying the point where action is applied and enter the applicable locator designation in parenthesis.

1.1.2.6 Information Source (6)

Substantiating documentation, drawings, or manuals by number will be listed. Include change letter as applicable. List each reference document, once only, with no individual operation reference.

1.1.2.7 Location (7)

Enter the alpha-numeric identifier which indicates the location at which each operation is performed. Sample location code number and location names are as follows:

NOTE: The locations listed relate primarily to KSC. As an interim measure, they may be used as a guide to the type of facilities available at other Apollo Program areas. The complete list will be developed as part of the operations concept criteria.

Letter Codes

A. KSC

B. MSFC

1.1.2.7 (Cont.)

Letter Codes (Cont.)

C. MTO

D. ML

E. SACTO

F. Contractor Facility

Number Codes

1 - Launch Control Center

2 - High Bay in the VAB

3 - Low Bay in the VAB

4 - Pad Area

5 - High Pressure Gas Storage Battery at VAB

6 - Converter Compressor Facility

7 - Mobile Servicing Platform Parking Area

8 - High Pressure Gas Storage Building

9 - Data Link Terminal Buildings

10 - Electrical Shop

11 - Heavy Equipment and Rigger Shop

12 - Machine Shop

13 - Communication Shop

14 - Photographic Laboratory

15 - Mechanical Systems Shop

16 - Measuring Laboratory

17 - RF Instrumentation Laboratory

18 - Gyro and Stabilizer Systems Laboratory

19 - Guidance and Control Test Support Area (Lab)

20 - Instrument Calibration and Standards Laboratory

21 - Propellant Systems Component Laboratory

Figure 1.1-4, sheets 1-5, show completed samples of the AVE Operations Flow sheets.

1.2 Requirements Analysis - AVE Operations Flow

The requirements analysis will identify and record the technical requirements for equipment, facilities and personnel tasks. (See Figure 1.2-1 for sample form.) The Line Item or OPN No. will cross reference the requirements analysis form to the Maintenance Activities Analysis or AVE Operations Flow sheet, as applicable. For each operation, the Requirements Analysis sheet will identify the technical requirements imposed by the operation; identify the equipment and facilities recommended to fulfill these technical requirements; and the personnel requirements in the form of task, skill, and elapsed time information. The requirements analysis forms will be completed as follows:

1.2.1 Line Item/OPN No. - (A)

Entries in this column shall correspond to the Line Item entry on the Maintenance Activities Analysis sheet or the operation dash number on the AVE Operations Flow sheet.

1.2.2 Technical Requirements - (B)

Entries in this column must be functionally oriented statements of what must be done in order to satisfy the technical requirements which are imposed by the operation being analyzed. These entries will not be keyed to existing equipment/facilities nor will they be a narrative description of how to perform. The "how" question is answered by the Personnel Tasks column (D-1). A checklist (paragraphs 1.2.2.1 through 1.2.2.5) will be used for insuring consideration of all characteristics or constraints. Only those functional technical requirements and constraints applicable to the specified operation will be described. These technical requirements will provide the basic design requirements, limitations, and any other essential characteristics imposed upon equipment and facility configuration

1.2.2 (Cont.)

by the operation. Entries will cover such items as structural requirements, special power requirements, environmental conditioning, facilities space requirments, etc. The same sheets shall be used to provide technical requirements for the maintenance functions described in subsequent paragraphs.

1.2.2.1 Functional Requirements

This portion of Technical Requirements will state, in engineering terms and specific values, the requirements to be satisfied by proposed or existing equipment in order to accomplish the function(s) for which it is recommended. It will identify all of the specific functional requirements which influence the need or configuration of the proposed end item.

1.2.2.2 Design Constraints

This portion of Technical Requirements will state those constraints imposed upon recommended design of the end item. For uniformity, the constraints shall be recorded as follows:

1.2.2.2.1 Power

Limitation regarding the type or quantity of power (electrical, hydraulic, pneumatic, etc.) which is available to the equipment, shall be stated.

1.2.2.2.2 Physical

Any physical constraints upon the design of the equipment such as maximum size, maximum weight or portability, shall be stated.

1.2.2.2.3 Interface

Any requirements for mechanical or electrical interface with other equipment(s) will be stated.

1.2.2.2.4 Environmental

Definitive statements regarding the environment which the

1.2.2.2.4 (Cont.)

equipment must be capable of withstanding shall be made in the following categories, as applicable:

a. Ambient - Covers natural and/or controlled environment to which the equipment will be exposed and includes maximum and minimum temperatures, air pressure, humidity and natural phenomena.

b. Dynamic - Covers movement and/or forces which the equipment must withstand, including vibration, shock, acceleration, etc.

1.2.2.2.5 Monitoring

Requirements for equipment monitoring, i.e., electrical, signal pressure, etc., shall be included.

1.2.2.2.6 Operating Life

The design objective for operating life shall be specified. In the event time cannot be specified, cycles of operation should be noted.

1.2.2.2.7 Safety Considerations

Any condition which could result in injury to personnel or damage to equipment must be identified and requirements to preclude occurrence shown.

1.2.3 Operability and Maintainability

This sub-topic covers any special features and/or requirements imposed by trade studies and analysis evaluation, to ensure the operability and/or maintainability of the equipment. It includes human engineering requirements, packaging requirements, fault isolation provisions, accessibility, etc.

1.2.4 Reliability

This paragraph states the reliability considerations imposed on

1.2.4 (Cont.)

the equipment and includes the factors of ground operating environment, human performance affects, cycling affects, etc. Where a specific reliability value, or goal, has been established for the type of equipment involved, this value shall be entered as a Required Reliability value or goal. Where qualification testing and/or available failure rate data indicates a probable higher reliability than that required, this shall be entered as an achieved Reliability. Where this occurs, reference the source. Where a specific reliability value, or goal, has not been established, this shall be noted, with the reason therefor. In the latter case, the best available state-of-the-art reliability values will be entered, with the source of the data. Where appropriate, applicable standards or exhibits, will be referenced. The values, or goals, entered will be repeated in the Design Criteria Sheets and the End Item Specification. Reliability studies of the completed design will be utilized to confirm the required reliability or will be cause for recommendation for redesign. The approved reliability values for the completed design will provide the basis for the reliability expressions used in System Simulation (Section 3.0) and for the Maintenance Activity Rate (Section 2.0).

1.2.5 Expendable Supplies

Expendable supplies are those items consumed during the performance of scheduled or unscheduled activities. Such items as propellants, pressurants, special grease, paint, cryogenic fluids, and sealing compounds fall in this category. A brief description of the technical requirement for such supplies should be provided in this column. The nomenclature and government or commercial specification number for the expendable fulfilling the requirement should be entered in the Nomenclature and Program Element No. subdivisions of column (C).

1.2.6 P.E.N., D.C., or S.E.R. Number - (C-1)

The Program Element Number (P.E.N.), Design Criteria (D.C.) reference, or Standard Equipment Requirements (S.E.R.) number for each of the items listed under Equipment/Facility Nomenclature will be included when available and/or assigned.

1.2.7 Equipment/Facility Nomenclature -(C-2)

This column shall contain the short form nomenclature of the existing item of AGE or facility recommended to meet each technical requirements. Where existing equipment/facility must be modified or where new equipment is required, the Equipment/Facility Nomenclature is left blank. The End Item Logistics Requirements Summary will identify and recommend the procurement of new or modified equipment/facility. The Location code of the existing facility which will satisfy each Technical Requirement will be entered. Location codes were defined in paragraph 1.1.2. Specific location within the facility should be described.

1.2.8 Personnel Information (D)

Personnel Information will be required to delineate tasks, skills, quantities, task times, special equipment and critical equipment and personnel performance affects. This requirement will provide the means to utilize common personnel skills for operations and maintenance functions and tasks, control the allocation of these personnel and assure the consideration of human performance affects on system and equipment design. The following paragraphs describe the application of this information during the requirements analysis.

1.2.8.1 Personnel Tasks - (D-1)

This column will contain the personnel tasks required to perform each operation or maintenance function. Entries shall be

1.2.8.1 (Cont.)

made in the form of statements sufficiently descriptive of each maintenance task to substantiate personnel numbers, types, and utilization of recommended equipment or facilities. Detail procedural instructions for performing the task requirements shall not be included. Wherever a maintenance task could endanger the safety of either personnel or equipment a note shall be included. The Note-Caution-Warning designation system of MIL-M-5474 shall be used for the preparation of these sheets. When analyzing unscheduled maintenance, the first entry in this column under the LOCALIZE or ISOLATE activity will be the malfunction symptom code (see paragraph 3.3.1.4) and a brief description of the malfunction symptom.

1.2.8.2 Type - (D-2)

The type of work and job skills necessary to perform each personnel task will be shown. A three-digit code will be used to identify type of personnel. The first digit is to indicate the personnel field, such as electrical or mechanical. The second digit is to indicate the specialty area, such as machinist or welder. The third digit is to indicate the job skill level, such as master, journeyman, or helper, and increases in proportion to the level of job skill. The lowest job skill level capable of performing the described task is to be assigned. Where more than one type is required to perform an activity, entries showing each Type will be made, underlined and summed for each Line Item/OPN No. A sample list of fields, specialty areas and job skill level titles are shown below. Complete definition of these fields, specialty areas and job skill levels will be accomplished in accordance with the U. S. Department of Labor "Dictionary of Occupational Titles."

1.2.8.2. (Cont.)

Field	Specialty Area
1 - Electrical	0 - Telemetry Systems
	1 - Communication Systems
	2 - Computer Systems
	3 - Radar Systems
	4 - Power Systems
	5 - Instrumentation
2 - Fluid Mechanics	
	0 - Pneudraulic
3 - Mechanical	
	0 - Sheet Metal and Structures
	1 - Welders
	2 - Machinist
	3 - Mechanic
4 - Ordnance	
5 - Transportration and Handling	
	0 - Rigger
	1 - Vehicle Operator
	2 - Handling Equipment Operator
6 - Support Services	
	0 - Supply
	1 - Facility Maintenance
7 - Safety	
8 - Operations	
	0 - Cryogenic
9 - Quality Control	0 - Inspector
	1 - Calibration Standards

Job Skill Level

1 - Helper

2 - Journeyman

3 - Master

1.2.8.2 (Cont.)

Example: Type 142 - The "1" indicates that an electrical man is required to successfully complete the described task. The "4" indicates the man is specialized in power systems and the "2" indicates he is a journeyman. A job description of the Electrical Field job skill levels is shown in Appendix C.

1.2.8.3 Elapsed Time - (D-3)

The estimated elapsed time (hours and decimals thereof) to perform each personnel task will be entered and the aggregate series/parallel time to perform each operation of the activities computed. Timed Flow sheets will be used, as a worksheet, to perform this computation. Enter and underline the aggregate time for each line item or operations number including the time required to transport spares, equipment and personnel. This information will be used in operability and maintainability trade studies and the time based flows.

1.2.8.4 Quantity - (D-4)

Enter the minimum number of each personnel type necessary to perform each task. The aggregate quantitative personnel requirement for each operation will be entered at the Line Item level.

1.2.8.5 Task Proficiency Level - (D-5)

This entry will indicate the personnel skill level needed to perform the described task. It will be obtained by selecting the skill level described in Appendix D which most nearly satisfies the task requirements. It will be indicative of the perceptual, judgmental, and motor skill demands made on human performance. A three-digit code will be used to indicate those demands. The first digit represents the perceptual demand. The second digit represents the judgmental demand and the third

1.2.8.5 (Cont.)

digit the motor skill required. It must be emphasized that the Personnel Task will dictate the level of performance demand.

1.2.8.6 Performance Criticality - (D-6)

Entries will indicate the effect on the system of nonperformance of improper performance of each maintenance task. The following code letters are used as appropriate:

Code

A - Little or no effect on the mission success.

B - Could result in some degradation of equipment, but would probably not affect mission success.

C - Mission success will be compromised to an unacceptable degree.

It should be noted that tasks identified as simple or low demand in job or personnel skill requirements may be rated as "C" in criticality because of the nature of the task and the time at which it is performed. During scheduled maintenance, failure to throw a switch might be rated "A". Failure to throw the same switch during unscheduled maintenance in the launch cycle might be rated "C" because delay past the launch window time constraint could result. Tasks rated as "A" should be evaluated to determine their necessity. This entry will be used to provide an order of rank relative to human or equipment malfunctions on system performance or mission success. It allows for selection of tasks which need to be stressed through training or procedural data or reevaluation of the man-machine interface.

1.3 Trade Studies--Operations

Trade Studies will be conducted in a systematic manner, utilizing all of the system parameters involved, to consider design and logistic alternatives in order to select the best approach for accomplishing a function.

1.3.1 Trade Study Comparison Sheet

Trade Study Comparison sheets will be used as a means for referencing the technical requirements of the function under consideration and for identifying and rating the alternate approaches in order to select the best one. A separate sheet will be used for each approach considered. A sample sheet is shown in Figure 1.3-1 and a guide to its completion follows. Typical completed samples are shown in Figure 2.3-1. The trade study examples shown describe only one of many techniques which may be used to appropriately trade off alternative approaches to arrive at the most desirable functional or technical solution. Of primary importance in the trade off process in the weighted consideration for all of the qualitative and quantitative parameters as shown in 1.3.1.6. The trade study technique used must be documented and accomplish the primary purpose described in Sections 1.3 and 2.3.

1.3.1.1 End Item

The designation of the end item, i.e., S-1C, SII, will be entered.

1.3.1.2 System

The nomenclature of the functional system which is or contains the area being considered will be entered.

1.3.1.3 PEN/OPS Activity No.

The PEN/OPS Activity No. will be obtained from the applicable requirements analysis form which established the technical requirements. It will be entered for cross reference.

1.3.1.4 Effectivity

The designation of the space vehicles or spacecrafts which could reflect the incorporation of the study results will be entered.

1.3.1.5 Proposed Solutions

A brief narrative description, in engineering terms, of the alternate approaches being considered on this sheet will be entered.

1.3.1.6 Parameters

The parameters to be considered in trade studies are:

Performance	Spares
Schedules	Weight
Safety	Human Factors
Reliability	Producibility
Maintainability	Personnel & Skills
Operation & Maintenance	Cost
Instructions	Other
Equipment	

All parameters which could be affected by any of proposed solutions will be determined and entered in this column.

1.3.1.7 Effect of Proposed Solution

Determination of the proposed solution's effect on each parameter listed must be determined by personnel best qualified to perform the evaluation. A description of the effect will be entered.

1.3.1.8 Relative Weighting

For each parameter selected, a weighting value which reflects its relative importance will be entered. A value of unity will be assigned to the least important parameter(s) and higher whole numbers will be assigned the others corresponding to their relative importance.

1.3.1.9 Desirability Rating

The system effect of the proposed solution must be rated for

1.3.1.9 (Cont.)

each parameter by personnel best qualified in that area. A common rating scale evolving around zero (no effect) with +100 as a necessary rating and -100 as unacceptable will be used and the rating entered. A maximum rating will be considered as a selection constraint.

1.3.1.10 Weighted Desirability Rating

The Relalative Weighting and Desirability Rating will be multiplied and the product entered in this column.

1.3.1.11 Totals

The Relative Weighting and Desirability Rating columns will be algebraically summed and entries made.

1.3.1.12 Average Net Desirability Rating

The total of the Weighted Desirability Rating will be divided by the Relative Weighting total and will be entered. Positive ratings are desirable and negative ratings are not. A compilation of the associated Trade Study Comparison sheets will be used to determine which alternate proposed solution will be recommended. As the average net desirability rating becomes more positive, desirability increases.

1.3.1.13 Relative Rank

The Weighted Desirability Rating of all proposed solutions will be ranked in order with the most desirable solution rated as 1. The rank order will be entered.

1.4 End Item Requirements--Operations

Design Criteria for system unique and standard equipment will be prepared to satisfy the technical requirements identified by the Requirements Analysis sheets. The Design Criteria sheet shown in Figure 1.4-1, shall be required for each prime equipment/facility contract end item, modified and unmodified

1.4 (Cont.)

inventory equipment item, engineering critical component or identification item. Standard Equipment Requirements sheets, described in paragraph 1.4.2 will be used for commercial or contractor Standard or Federal Stock listed standard tools, test equipment and bulk material. Design Criteria sheets Section D will be included in Section 3 of the Contract End Item detail specifications.

1.4.1 Design Criteria Sheets

1.4.1.1 DC Number - (A)

Enter the serial number of the Design Criteria Sheet. This number to be assigned by the Originator/Contractor. This number shall be followed (in parenthesis) by one of the three letters indicated below which shall designate the classification of the Design Criteria:

(N) Indicates a requirement for manufacture or procurement of a new end item of AGE or facility.

(M) Indicates a requirement to modify an existing end item of OGE, MGE or facility.

(V) Indicates that the operations (or maintenance) analysis verifies that an existing end item of AGE will adequately fulfill its system requirements.

1.4.1.2 Revisions - (B)

Entries in this section shall be made whenever a change is made to an approved Design Criteria Sheet. Enter the revision symbol (A to Z) in column B 1, a brief description of the change and a reference to the configuration control document authorizing the change in column B 2, the date of the revision in column B 3, and the signature of the person responsible for authorizing the change in column B 4.

1.4.1.3 Reference - (C)

Enter 'Operations Analysis' or 'Maintenance Analysis' to identify the origin of the requirement. Enter the operational or maintenance activity number, the P.E.N., the Requirements Analysis Sheet number, and Technical Requirement line item identifier.

1.4.1.4 Requirements (D)

This section shall specify the limiting functional characteristics of the end item. This includes performance characteristics which are established by and are the product of requirements analysis. It will contain detail design requirements information which can be used in the procurement of the detail design effort. Performance requirements entries in this section are technically identical with Technical Requirements established by the Requirements Analysis. This section shall specify design requirements for the contract end item by:

a. Providing the "design to" forcing function for engineering design of new and modified equipment and facilities.

b. Providing validation of unmodified inventory equipment, facilities and identification items.

c. Providing specific numerical values, limits, ranges and applicable tolerances.

Contract end item design requirements shall be specified in accordance with NPC 500-1 detail specifications format applicable to the CEI category, e.g.: Prime Equipment, Facility, etc.

1.4.1.5 Originator/Contractor - (E)

Enter the originator's office symbol or contractor's company name.

1.4.1.6 Original Date - (F)

Enter the date that the sheet is originally released by the originator/contractor.

1.4.1.7 Engineer - (G)

This entry is the signature of the engineer who prepared the Design Criteria Sheet.

1.4.1.8 Checked - (H)

Enter the initials of the lead engineer who checked the Design Criteria Sheet.

1.4.1.9 Approved - (J) and (K)

Enter the initials of supervising engineer.

1.4.1.10 Submitted - (L)

Enter the signature of the contractor representative responsible for preparation and submittal of the Design Criteria Sheet.

1.4.1.11 Approved - (M)

This entry is the signature of the designated representative of the NASA technical organization responsible for the design of contract end item.

1.4.1.12 Nomenclature - (N)

Enter the short form nomenclature of the contract end item the design criteria defines.

1.4.1.13 Type - (O)

Enter the abbreviated category of equipment, i.e., AVE, OGE, MGE or Facility equipment.

1.4.1.14 CEI Category - (P)

Enter the CEI Specification category of the end item, i.e., prime equipment, facility, identification item, requirement

1.4.1.14 (Cont.)

item or critical component, as defined by NPC 500-1, Exhibits II, III, IV, V and VI.

1.4.1.15 CEI or Critical Code No. - (Q)

Enter the CEI or Critical Component Code identification and Detail Specification number assigned to the Contract End Item. These numbers shall be assigned in accordance with the requirements in Exhibit X of NPC 500-1.

1.4.1.16 Mfg. Model/Part No. - (R)

Enter the manufacturer's identification of the end item by its model or part number when it becomes available.

1.4.1.17 NASA Technical Organization Responsible - (S)

Enter the name or symbol of the NASA organization which has the design responsibility for the end item.

1.4.1.18 Project/System Designation - (T)

Enter the project and major end item, i.e., Saturn V/S-IC, Saturn V/S-IVB.

1.4.1.19 Program Element Number - (U)

The Program Element Number of the end item which will satisfy the requirements will be entered when it becomes available from the Equipment Management System List.

1.4.1.20 Detail Specification Number - (V)

Enter the Detail Specification number of the Contract End Item when it becomes available.

1.4.1.21 Title Block

Enter the complete name of the NASA Center responsible for the design of the end item.

1.4.2 Standard Equipment Requirements Sheets

Standard Equipment Requirement sheets, utilizing source information from the Requirements Analysis sheets, shall be prepared in the format shown in Figure 1.4-2. A Standard Equipment Requirements sheet shall be required for each item of equipment or material which is a commercial or contractor standard part, Federal Stock listed tools or test equipment or Federal Stock Listed Materials. The Standard Equipment Requirements sheet will be appended to and become a part of Section 3 of the contract End Item Detail Specifications for Identification and Requirement Items. (Reference NPC 500-1).

1.4.2.1 Nomenclature, FSC and P.E.N.

Enter the short form nomenclature of the standard equipment contract end item and the Apollo Program Element Number of the end item.

1.4.2.2 Numerical Identification (Federal Class Code, Federal Item Identification P/N and Mfg. Code)

Enter the Federal Class Code of the end item, the Federal Item Identification Number of the item, the commercial or contractor's standard part number and the manufacturer's Federal Code Number.

1.4.2.3 Item Description/Remarks

Enter a brief description of the end item; e.g., a particular end item such as a milliammeter might be described as follows:

(a) Portable type, metal case, d.c. direct application, scales 0-1 ma, 0-10 ma, 0-50 ma, 0-500 ma, each with 50 scale divisions, over-all dimensions 4" x 8" excluding handles; accuracy $\pm$ 2% full scale, sensitivity 100 mv drop across terminals; meter self-contained. (b) Recommend allocation to - (list shops and quantities) if applicable.

1.4.2.3 (Cont.)

Enter the applicable CEI detail specification category as defined in NPC 500-1, e.g.: Exhibit IV (Identification Item) or Exhibit V (Requirement Item).

1.4.2.4 Technical Requirement Origin

Enter "Operations Analysis" or "Maintenance Analysis" to identify the origin of the requirement. Enter the operational or Maintenance Analysis activity number, the PEN and the Requirements Analysis sheet line item and requirement identifier (numbers or letters). Data for this entry is obtainable from applicable Requirements Analysis sheets as a cross-reference identification.

1.4.2.5 Technical Requirements

Enter a description of the functional requirement for the end item. This information is technically identical to the technical requirements shown on applicable Requirements Analysis sheets.

1.5 Timed Flow Analysis - Operations

Timed flow analyses will provide graphic presentation of system functions against a time base to show the point in time at which they start, their duration, and their series-parallel relationships. The analyses will be used as building blocks to assemble tasks into operations, operations into activities, and to integrate activities into system and site time based flows. The results of the timed flow will be utilized to evaluate system effectiveness in terms of performance time, and equipment and personnel utilization time. Personnel tasks are the most minute element considered. They will be the basic unit from which to build. Each task will have been listed and its elapsed time shown on the Requirements Analysis sheet. The series-parallel relationship of the tasks will be established by means of horizontal bars on the Timed Flow sheet (Figure 1.5-1) to

1.5 (Cont.)

establish the start and stop time(s) of the operation they comprise. Equipment operating time (man or machine initiated), transportation, and supply times must be included when appropriate. The total operation could be performed in increments with dead time between tasks. For example, in a "gain access" operation, the technical requirement to set up or assemble platforms could be performed two days prior to the pure personnel task of ascending the platform to remove a cover plate. During the two-day interim, personnel are not being utilized in that operation, but the equipment (platforms) has been restricted from use in other locations. The method for timed bar presentation will be to use a solid bar for concurrent personnel and equipment utilization and a dashed bar when the equipment is operating or restricted from other uses. A similar method will be used to assemble the operations into activities and to integrate the activities into system, and ultimately site success path time based flow.

1.5.1 Timed Flow Sheets

1.5.1.1 PEN/OPS Activity No.

Enter the PEN/OPS Activity No. of the operation or activity being analyzed.

1.5.1.2 Type of Maintenance

This part is used only for a maintenance timed flow analysis. Enter "scheduled" or "unscheduled" in this column to indicate the type of maintenance involved.

1.5.1.3 Cross Reference

Enter the page number and line item or operations dash number of each Activity/Operation/Task listed from either the Maintenance or Operations Requirements Analysis sheet as appropriate.

A. If a maintenance timed flow analysis is being performed,

1.5.1.3 (Cont.)

enter the location code from the Maintenance Activities Analysis sheet.

B. If an operational timed flow analysis is being performed, enter the location code from the AVE Operations Flow sheet.

1.5.1.5 Activity/Operation/Task

Enter the title of each task, operation, or activity in the appropriate sequence to perform the job operation.

1.5.1.6 Hours

Entries will be in time bar form and will be in consonance with the series-parallel approach shown in Figure 1.5-1.

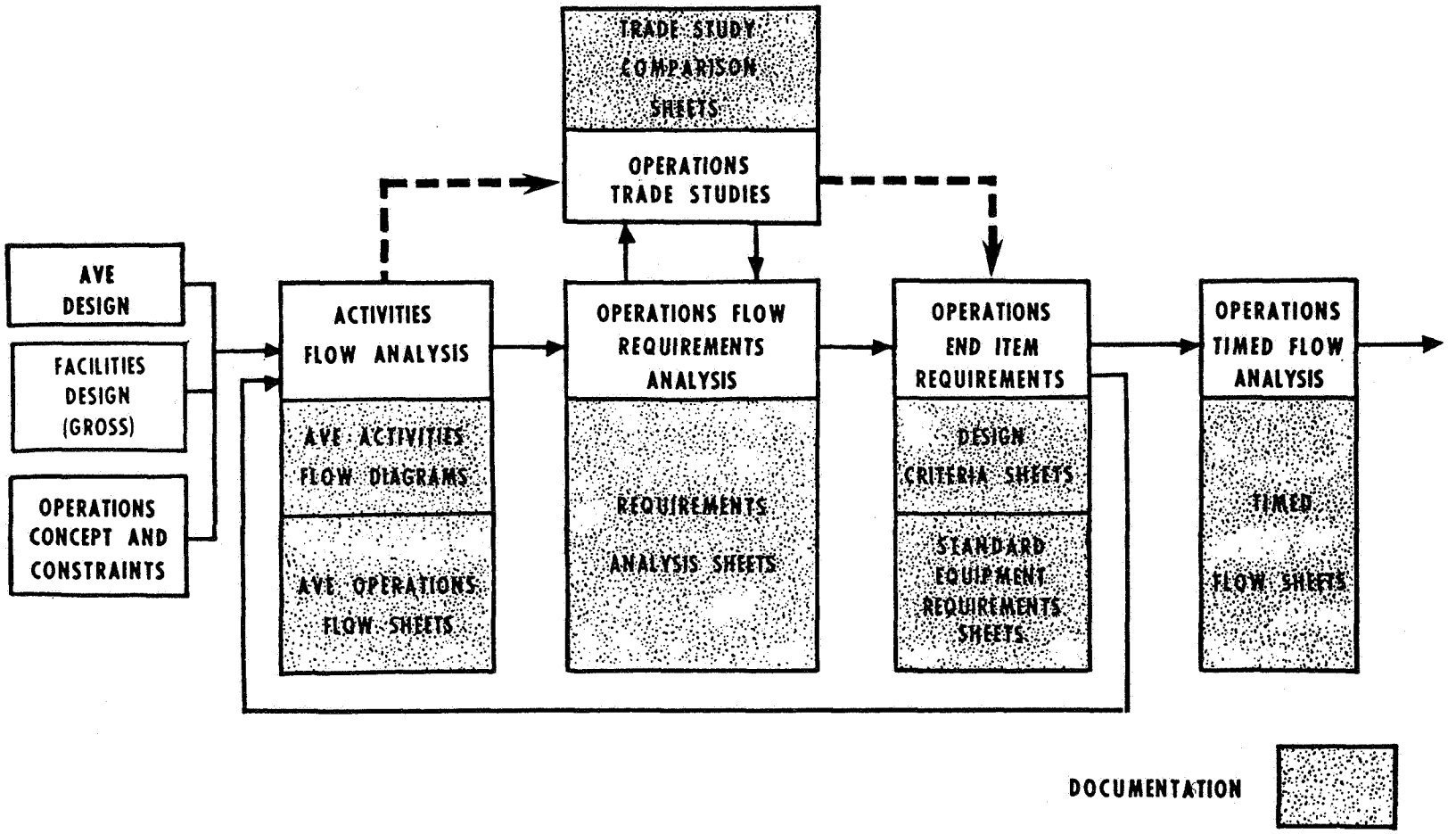


FIGURE 1.0-1; LOGISTICS BASELINES DERIVATION AND RELATED DOCUMENTATION

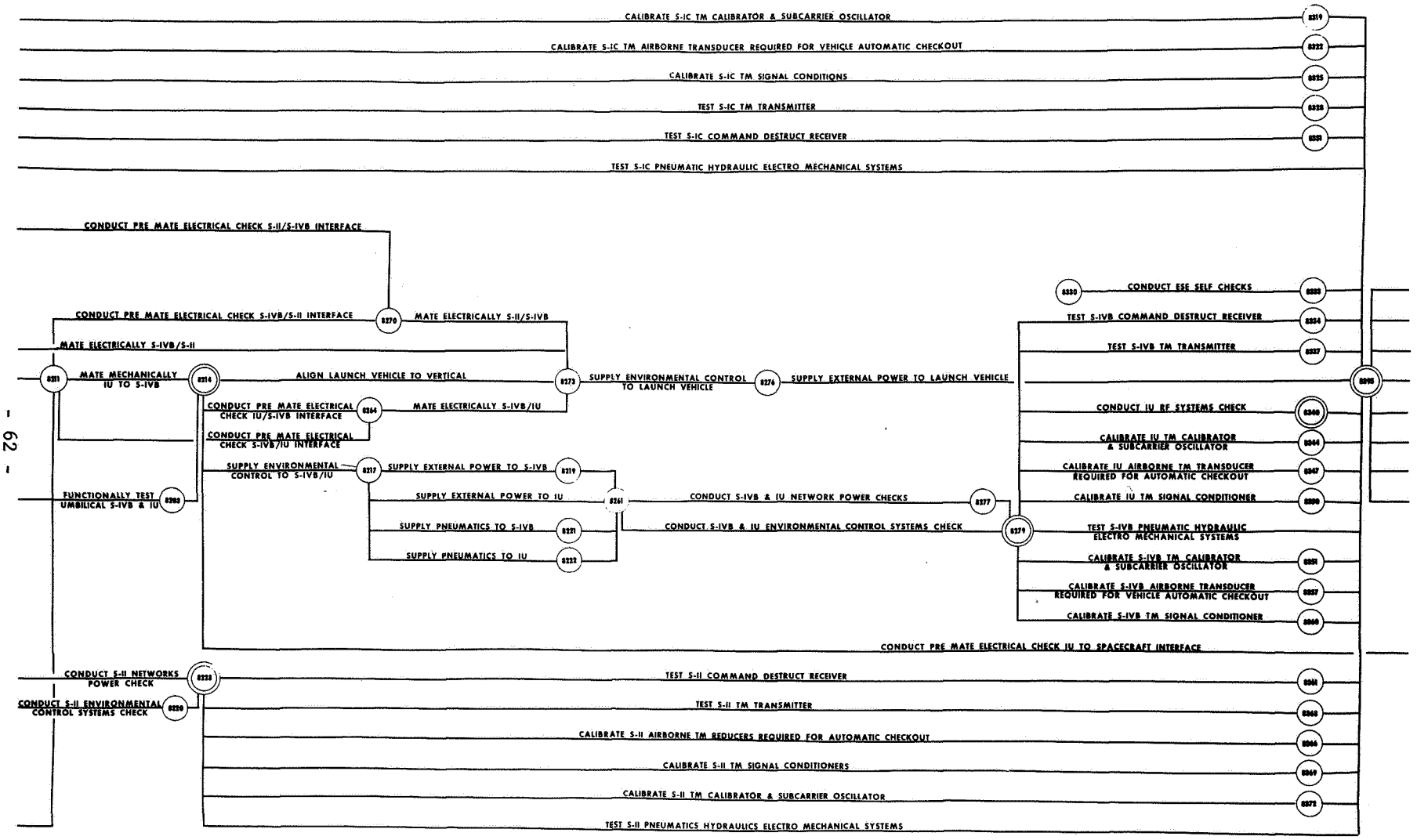


FIGURE 1.1-1; SAMPLE AVE ACTIVITIES FLOW DIAGRAM

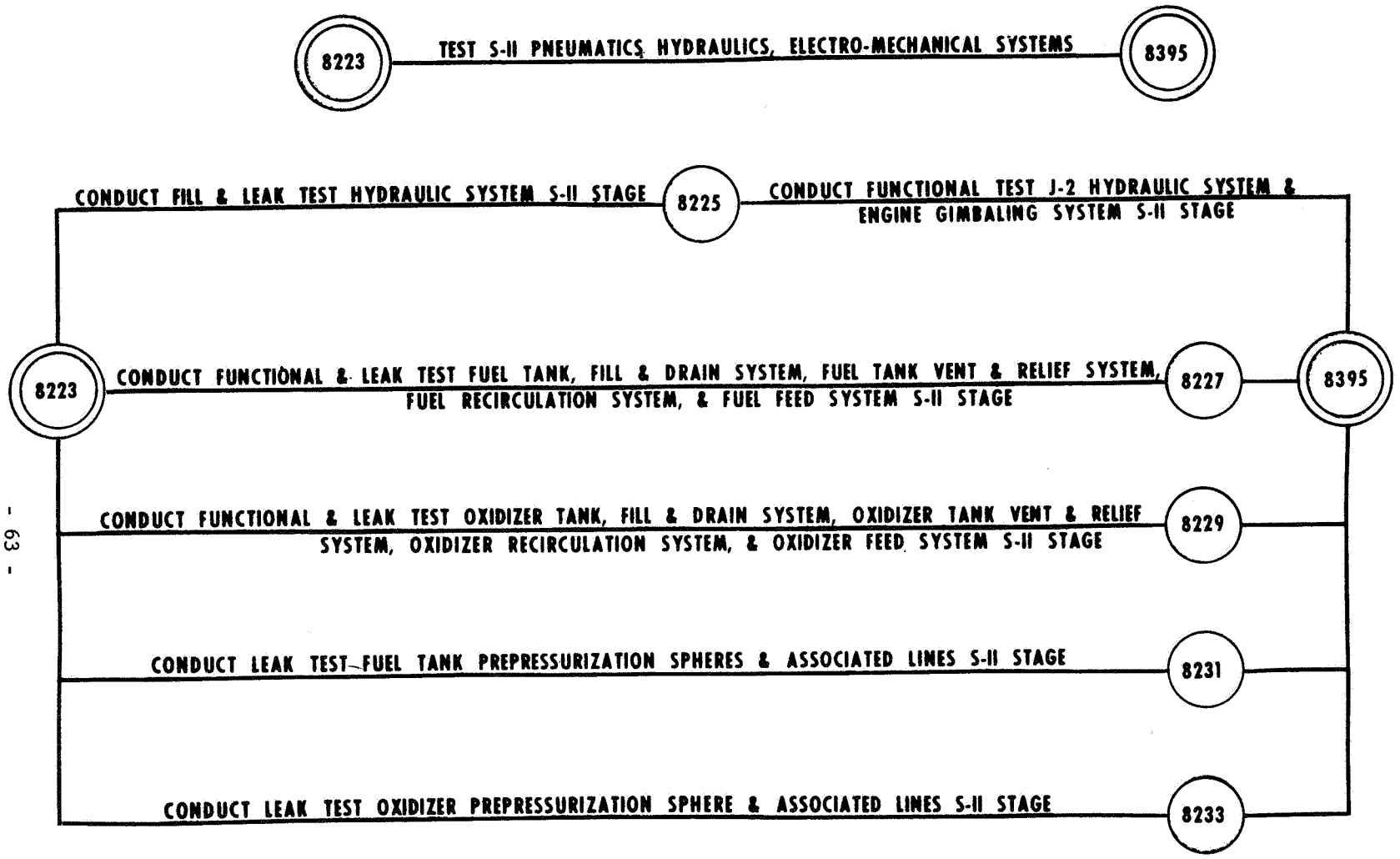


FIGURE 1.1-2; SAMPLE AVE ACTIVITIES FLOW DIAGRAM SHEET

AVE OPERATIONS FLOW SHEET

1. ACTIVITY NUMBER _____

2. ACTIVITY TITLE _____

4. OPERATION NO.	5. OPERATION TITLE	6. INFORMATION SOURCE	7. LOC.

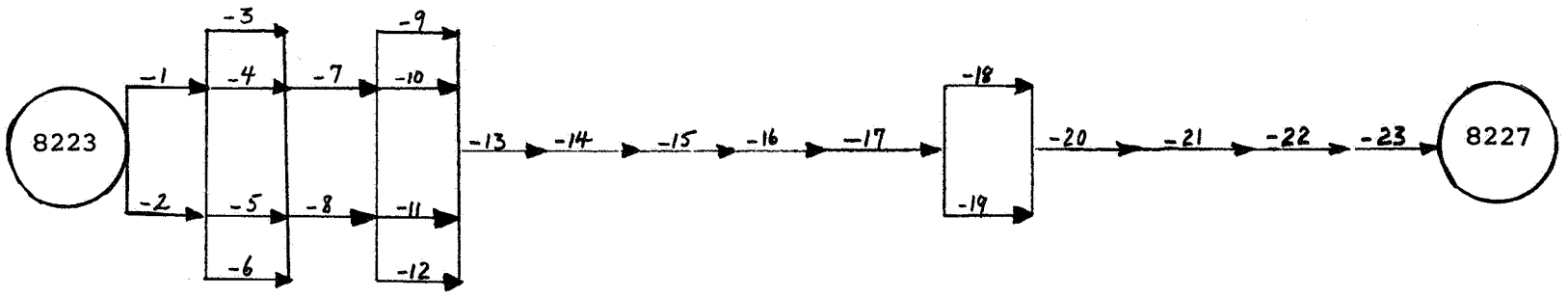
SHEET _____ OF ____ ORIG. DATE _____ REV. DATE _____ REV. LETR. _____ ACTIVITY NUMBER _____

FIGURE 1.1-3; SAMPLE AVE OPERATIONS FLOW SHEET

AVE OPERATIONS FLOW SHEET

ACTIVITY NUMBER 8223.8227

ACTIVITY TITLE CONDUCT FUNCTIONAL AND LEAK TEST FUEL TANK FILL AND DRAIN SYSTEM, FUEL TANK VENT AND RELIEF SYSTEM, FUEL RECIRCULATION SYSTEM AND FUEL FEED SYSTEM S-11 STAGE



OPERATION NO.	OPERATION TITLE	INFORMATION SOURCE	LOC.
-1	Gain access for operations -7, -8, -12, -13, -19	20M97009/B	
-2	Gain access to umbilical (——|——)	20M97011	
-3	Energize GROUND DC BUS (2D40) through WIJI		
	(Aft Umbilical)		
-4	Energize GROUND DC BUS (2D40) through WIJI		
	(Forward Umbilical)		
-5	Energize MAIN BUS (2D11) through WIJI		
	(Aft Umbilical)		

SHEET 1 OF 5 ORIG. DATE 2-3-65 REV. DATE _____ REV. LETR. _____ ACTIVITY NUMBER 8223.8227

FIGURE 1.1-4; SHEET 1, COMPLETED SAMPLE AVE OPERATIONS FLOW SHEET

AVE OPERATIONS FLOW SHEET

ACTIVITY NUMBER 8223.8227

OPERATION NO.	OPERATION TITLE	INFORMATION SOURCE	LOC.
-6	Energize INSTRUMENTATION BUS (2D21) through		
	WIJI (Aft Umbilical)		
-7	Pressurize PNEUMATIC ACTUATION SYSTEM through		
	COUPLING (C303)		
-8	Pressurize PNEUMATIC ACTUATION SYSTEM HELIUM		
	FILL through COUPLING (C305)		
-9	Energize SOLENOID ACTUATED VALVE (C312)		
	through (———/———)		
-10	Energize SOLENOID CONTROL VALVE, of FUEL TANK		
	PRESSURIZATION REGULATOR ASSEMBLY (C114),		
	through (———/·····)		
-11	Energize CONTROL SOLENOID of FUEL TANK		
	PREVALVE (C129) through ( )		
-12	Pressurize FUEL FILL AND DRAIN LINE through		
	CCUPLING (C139)		

SHEET 2 OF 5 ORIG. DATE 2-3-65 REV. DATE _____ REV. LETR. _____ ACTIVITY NUMBER 8223.8227

FIGURE 1.1-4; SHEET 2, COMPLETED SAMPLE AVE OPERATIONS FLOW SHEET

AVE OPERATIONS FLOW SHEET

ACTIVITY NUMBER 8223.8227

OPERATION NO.	OPERATION TITLE	INFORMATION SOURCE	LOC.
-13	Monitor for leakage FUEL FILL AND DRAIN LINE		
	and FUEL FILL AND DRAIN VALVE (C128)		
-14	Energize FUEL FILL AND DRAIN CONTROL SOLENOID		
	(C128) through (——/——)		
-15	Monitor OPEN FUEL FILL AND DRAIN VALVE (C128)		
	through (——|——)		
-16	De-energize CONTROL SOLENOID of FUEL FILL AND		
	DRAIN VALVE (C128) through (——|——)		
-17	Monitor FUEL FILL AND DRAIN VALVE for CLOSED		
	indication through (——/——)		
-18	Monitor FUEL TANK VENT AND RELIEF VALVES		
	(C108) for CLOSED indication		
-19	Monitor for leakage:		
	a) FUEL TANK VENT VALVE (C108) (2 valves)		
	b) FUEL TANK PREPRESSURIZATION SOLENOID		
	VALVE (C113)		

SHEET 3 OF 5 ORIG. DATE 2-3-65 REV. DATE _____ REV. LETR. _____ ACTIVITY NUMBER 8223.8227

FIGURE 1.1-4; SHEET 3, COMPLETED SAMPLE AVE OPERATIONS FLOW SHEET

AVE OPERATIONS FLOW SHEET

ACTIVITY NUMBER 8223.8227

OPERATION NO.	OPERATION TITLE	INFORMATION SOURCE	LOC.
	c) FUEL TANK PREPRESSURIZATION REGULATOR (C114)		
	d) RECIRCULATION VALVE (C116)		
	e) FUEL PREVALVES (C129-1, C129-2, C129-3,		
	C129-4, C129-5)		
	f) RECIRCULATION VALVE (C134) (5 valves)		
	g) FUEL TANK		
	h) The ASSOCIATED LINES from the fuel tank to		
	the valves, a) through f) above		
-20	De-energize CONTROL SOLENOID of FUEL TANK		
	PRESSURIZATION REGULATOR ASSEMBLY (C114)		
	through (——/——)		
-21	Monitor for leakage the ASSOCIATED LINES from		
	REGULATOR ASSEMBLY (C114) to CHECK VALVES		
	(C141, C142, C140) (3 valves for each engine)		
-22	Energize CONTROL SOLENOID of FUEL TANK VENT		
	AND RELIEF VALVES (C108) through (——/——)		

SHEET 4 OF 5 ORIG. DATE 2-3-65 REV. DATE _____ REV. LETR. _____ ACTIVITY NUMBER 8223.8227

FIGURE 1.1-4; SHEET 4, COMPLETED SAMPLE AVE OPERATIONS FLOW SHEET

AVE OPERATIONS FLOW SHEET

ACTIVITY NUMBER 8223.8227

OPERATION NO.	OPERATION TITLE	INFORMATION SOURCE	LOC.
-23	Monitor FUEL TANK VENT AND RELIEF VALVE for		
	OPEN indication through (——— / ———)		

SHEET 5 OF 5 ORIG. DATE 2-3-65 REV. DATE _____ REV. LETR. _____ ACTIVITY NUMBER 8223.8227

FIGURE 1.1-4; SHEET 5, COMPLETED SAMPLE AVE OPERATIONS FLOW SHEET

LINE ITEM/OP'N NO. A	B TECHNICAL REQUIREMENTS	C EQUIPMENT/FACILITY IDENTIFICATION		D PERSONNEL INFORMATION					
		P.E.N. D.C. S.E.R. NO. 1	EQUIPMENT/ FACILITY NOMENCLATURE 2	PERSONNEL TASKS 1	PERSONNEL REQUIREMENTS				
					TYPE 2	ELAPSED TIME 3	QUANTITY 4	TASK PROF LEVEL 5	PERF. CRIT. 6

REQUIREMENTS ANALYSIS SHEET

SHEET ____ OF ____

ORIGINAL DATE _____

REVISION DATE _____

PREPARED BY _____

PART NO. & REV. LTR. _____

P.E.N./OPS ACTIVITY NO. _____

FIGURE 1.2-1; SAMPLE REQUIREMENTS ANALYSIS SHEET

END ITEM _____
SYSTEM _____
PEN/OPS ACTIVITY NO. _____
EFFECTIVITY _____
PROPOSED SOLUTION _____

TRADE STUDY COMPARISON SHEET

TRADE-OFF NO: _____
DATE: _____

PARAMETERS	EFFECT OF PROPOSED SOLUTION	RELATIVE WEIGHTING	DESIRABILITY RATING	WEIGHTED DESIRABILITY RATING
			TOTALS	

AVERAGE NET DESIRABILITY RATING _____

RELATIVE RANK _____

FIGURE 1.3-1: SAMPLE TRADE STUDY COMPARISON SHEET

DESIGN CRITERIA SHEET	A DC _____

B REVISIONS			
1 SYM	2 DESCRIPTION	3 DATE	4 APPROVAL

C REFERENCE	D REQUIREMENTS
	SEE FIGURE 2.4-1 FOR COMPLETED ILLUSTRATIVE SAMPLE

ORIGINATOR/CONTRACTOR E	NOMENCLATURE N	GEORGE C. MARSHALL SPACE FLIGHT CENTER National Aeronautics and Space Administration
ORIGINAL DATE F		NASA TECH. ORGN. RESP. S
ENGINEER G / CHECKED H		
APPROVED J / APPROVED K	TYPE O	PROJECT/SYSTEM DESIGNATION T
SUBMITTED L	CEI CATEGORY P	PROGRAM ELEMENT NO. U
APPROVED M	CEI/CRITICAL CODE NO. Q	DETAIL SPEC. NO. V
	MFG. MODEL/PART NO. R	SHEET OF W

FIGURE 1.4-1; SHEET 1, SAMPLE DESIGN CRITERIA SHEET

DESIGN CRITERIA SHEET (cont.)	DC _____
C REFERENCE	D REQUIREMENTS
	SEE FIGURE 2.4-1 FOR COMPLETED ILLUSTRATIVE SAMPLE
	SHEET OF

FIGURE 1.4-1; SHEET 2, SAMPLE DESIGN CRITERIA SHEET

STANDARD EQUIPMENT REQUIREMENTS								FEDERAL CLASS CODE	FEDERAL ITEM IDENT NUMBER
Nomenclature:								P/N: Mfr. Code:	
P.E.N.									
Location	ML1	ML2	ML3	ML4	VAB High Bay	VAB Low Bay	LCC	Support Shops	Other Areas
Quantity									
Item Description/Remarks:									
Technical Requirement Origin	Technical Requirement								
	SEE FIGURE 2.4-2 FOR COMPLETED SAMPLE FORM								

FIGURE 1.4-2; SAMPLE STANDARD EQUIPMENT REQUIREMENTS SHEET

LOGISTICS BASELINE MAINTENANCE REQUIREMENTS > TIMED FLOW SHEET

PEN/OPS ACTIVITY NO.	TYPE OF MAINTENANCE		PREPARED BY	APPROVED BY
CROSS REFERENCE	LOCATION	ACTIVITIES/OPERATIONS/TASKS	HOURS	

FIGURE 1.5-1. SAMPLE TIMED FLOW SHEET

2.0 MAINTENANCE REQUIREMENTS ANALYSIS

Maintenance Requirements Analysis will provide data to preclude or reduce the effect of contingencies which cause deviation from the systems operational success path due to equipment malfunction. The analysis will be developed by utilizing the AVE of specified design, the logistics baseline outputs and the maintenance concept as basic source information. The logistics baseline requirements are described in paragraphs 1.0 through 1.5. The general maintenance concept for the Apollo Program follows and will be developed in detail by the NASA organizations.

2.0.1 Maintenance Concept

The maintenance concept is the anticipated manner in which the maintenance on a systems and/or equipment is to be performed. Maintenance is the function of retaining material in or restoring it to a serviceable condition. In general, the Apollo Program maintenance concept will be remove and replace to the functional component level, either on a scheduled basis which is determined by design life characteristics, or on an unscheduled basis as a result of malfunction. Detailed requirements for maintenance on the system and/or equipment will be derived from the maintenance requirements analysis and will be dependent on the equipment design and the inherent fault localization and verification capability of the system test and checkout equipment as identified in the logistics baseline. As justified by the maintenance requirements analysis and associated trade studies, repair-in-place may be accomplished. Factors which will be considered for repair-in-place are economy, time and size or location of the failed unit. Failed units will be repaired, either at the second or third level maintenance facilities, as determined by the maintenance requirements analysis. NASA organizations will assure that maintenance

2.0.1 (Cont.)

planning accounts for facility space, equipment and all other repair capabilities necessary at these locations.

2.0.1.1 Types of Maintenance

2.0.1.1.1 Scheduled Maintenance

Any planned preventative maintenance deemed necessary to ensure the functional success of the equipment (i.e., design life replacement, servicing with consumables, etc.)

2.0.1.1.2 Unscheduled Maintenance

Any corrective maintenance which is required as a result of failure, regardless of the circumstances under which that failure occurred. Preventative maintenance may be included on a situation-demand basis.

2.0.1.2 Levels and Locations of Maintenance

Levels of maintenance will be established for each equipment end item as follows, and will be justified by analysis.

2.0.1.2.1 First Level Maintenance

Those maintenance actions which are accomplished directly on the system installed hardware. This includes system fault isolation, repair in place, removal and replacement of sub-systems or components, checkout, servicing and inspection. Maintenance support for AVE, and OGE used in direct support of the AVE flow, will give prime consideration to definitive fault isolation to a replaceable or reparable component level, and maintenance accomplishment in minimum down time.

2.0.1.2.2 Second Level Maintenance

Those maintenance actions required in direct support of First Level Maintenance, and accomplished in field support shops located at the test and/or operations site. This

involves disposition and/or repair of items removed during first level maintenance. Second level maintenance support will include fault isolation to lower level reparables and nonreparables, and repair capability based upon a cost-effective use of maintenance resources. Second level modification will normally be restricted to those actions which can be accomplished by the use of previously provided second level type maintenance personnel, equipment and facility space.

In addition, because this level of maintenance will provide both technical and management support to first level maintenance, the following are included in the second level maintenance responsibilities:

a. Provide MGE and personnel on call to assist in malfunction isolation and repair during first level maintenance.

b. Receive malfunctioned and time compliance items from first level maintenance and provide replacement items.

c. Maintain log entries relating to malfunctions and prior maintenance.

d. When malfunctions occur:

   (1) Determine by failure analysis, using appropriate instructions data, if the failure could have been caused by another system failure, or if it could have caused an additional system failure. Determine if previous maintenance could have resulted in the malfunction.

   (2) Report findings and request checkout of other system equipment for malfunction or prior maintenance affects, as required.

   (3) Determine from repair instruction data, whether the removed item is to be repaired at second level or sent to factory or overhaul facility.

2.0.1.2.2 (Cont.)

(4) Perform authorized repairs on all components, package and ship, or dispose of components as determined from the appropriate maintenance or supply instructions.

(5) Compile all known facts relative to the malfunction and forward with the malfunctioned item to the next maintenance level.

e. Prepare an unsatisfactory report on those items which have failed.

f. Provide a log on equipment operating time and operating cycle data as well as disposable-at-failure and consumable usage rates to supply.

g. Control prime, launch and/or test critical items, ship reparable items and order replacements as required for second level maintenance and in accordance with supply procedures.

h. Maintain second level instructions, including configuration control and updating.

2.0.1.2.3 Third Level Maintenance

Those maintenance actions which are required in direct support of first and second level maintenance and accomplished in a remote location (factory or overhaul facility). It generally involves the use of a maintenance element not normally available at first and second level maintenance facilities due to cost, frequency, safety, manpower, skills, unusual facility requirements or other considerations. Maintenance support at this level will include complete malfunction isolation capability, complete failure analysis capability, complete modification capability, and complete rebuild capability.

2.0.2 Maintenance Requirements Analysis Rationale

In performing maintenance requirements analysis, the concept

2.0.2 (Cont.)

of a complete "maintenance activity loop" will be applied to develop the basic maintenance flow. The maintenance activities loop will consist of a sequence of maintenance activities performed to accomplish a repair or servicing cycle. For repair it includes all activities necessary to isolate a fault, repair the faulty component/subsystem, and verify that the equipment has been returned to operational status. For servicing, it includes all necessary preparation, servicing, and reactivation operations that return the equipment to operating condition. The term "maintenance activities loop" will be applicable to all maintenance except for assembly when launch vehicle disassembly and assembly is required to complete a maintenance activity loop, the term "demate-mate" will be used to cover the disassembly and assembly activities.

Maintenance requirements analyses will be performed to cover all those unscheduled system and equipment malfunctions which may occur during the AVE operations flow. The analysis will identify and record all maintenance activities necessary to correct the faults and return the operational system to the success path condition. Figure 2.0-1 shows the maintenance activities loop relationship to the AVE operations flow. Analysis of scheduled type maintenance will also be performed covering all equipment requirements for periodic servicing (grease, oil, adjustments, calibration, etc.). Analysis of scheduled replacement or rework of parts is also necessary when the design life limit of those parts requires scheduled maintenance prior to their wear-out.

2.0.3 Maintenance Requirements Analysis Functions

The functions required to perform maintenance requirements analysis are as follows:

a. Establish the maintenance flow in functional terms to

2.0.3 (Cont.)

describe the maintenance activities loop. The flow will be established in accordance with the Maintenance Activities Analysis described in paragraph 2.1.

b. Define the technical requirements which are imposed by the AVE/AGE functions and apportion those requirements to equipment, facilities, and personnel. Definition will be provided by performing a Maintenance Activities Requirements Analysis per paragraph 2.2.

c. Conduct studies to systematically consider design and logistic alternatives and select the best approach for accomplishing a function. The Trade Studies will be conducted as described in paragraph 2.3.

d. Define equipment and facility performance requirements in engineering terms to provide criteria for detail design. Design Criteria sheets and Standard Equipment Requirements sheets will be completed per paragraph 2.4.

e. Depict the time base sequential and parallel relationship of the maintenance functions to determine equipment, facilities, and personnel utilization time. The Maintenance Activities Timed Flow will be conducted as shown in paragraph 2.5.

f. Prepare an End Item Logistics Requirements Summary that will summarize logistic resources and services identified by the logistic baseline and maintenance requirements analysis to support each contract end item.

The Maintenance Requirements Analysis functions and associated documentation are shown in Figure 2.0-2. A description of the functions and details relating to the preparation of the documentation follows.

2.1 Maintenance Activities Analysis

The Maintenance Activities Analysis will sequentially delineate

2.1 (Cont.)

all operations necessary to repair or service the system/equipment which is being analyzed. The maintenance activities generated will be entered on the Maintenance Activities Analysis sheet (Figure 2.1-1). The sheet will serve as a flow diagram to the lowest maintenance activity level and will (1) identify the system or item(s) of hardware to the necessary indenture (functional component) level, (2) provide spares provisioning and maintainability data, (3) identify the need for maintenance instructions, (4) identify maintenance level, location, and type, and (5) list mean time between failure (maintenance action rate) information. A completed sample sheet is shown as Figure 2.1-2. The maintenance activities loop established will be developed in subsequent paragraphs.

2.1.1 Maintenance Activities Analysis Sheet

2.1.1.1 Program Element No./OPS Activity No. (A-1)

Program Element Numbering is the key to the identification system. All functional elements are assigned numbers. As the functional classification proceeds from the general to more specific levels of detail, additional digits are added to the Program Element Number (PEN). For instance, the numeral 2 identifies the Vehicle System; 22 is Vehicle AGE; 222 is Vehicle Stage AGE; 2222 is Vehicle Stage AGE transportation and handling equipment. Digits are added as necessary until the element under consideration is described (see Appendix E). The PEN is obtained from the applicable Equipment Management System List.

The AVE Operations Flow sheet activity and operation dash number which will generate unscheduled maintenance analysis will also be entered. The number(s) will be entered in space A-1 in the upper left and also in the lower right hand corners of the form.

2.1.1.2 Part No. and Rev. Letter (A-2)

The part number, revision letter and latest Engineering Orders are obtained for the end item from the applicable drawing and the Equipment Management System List. The entry will be made in column A-2 and the lower right hand corner of the form. It will be used as an identifier and for cross reference with the Program Element Number.

2.1.1.3 Line Item (Cross Ref.) (A-3)

This column will provide a source of cross reference to be used to relate the other analysis sheets to the Matinenance Activities. Separate entries in sequential order are made for each selected operation of the maintenance loop.

2.1.1.4 Indenture Number (A-4)

This number will be used to indicate the installation and assembly levels for all systems and assemblies which may require maintenance. The indenture level is indicated by the PEN system. The maintenance requirements analysis shall be prepared starting with the PEN level of the system being considered for vehicle maintenance, or the end item for AGE maintenance, and progress to subassemblies and components, in numerical order. Indenture numbers increase in direct proportion to the number of digits in the PEN.

2.1.1.5 Nomenclature/PEN Identifier (A-5)

Enter the name and the PEN/OPS Activity No. of the item(s) of AVE or AGE for each indenture which has been identified. The nomenclature entry for the system or end item of equipment being considered will also be made at the bottom of the sheet. Use the name of each item as identified on the applicable engineering drawing.

2.1.1.6 Mfg./Part No. and Rev. No. (A-6)

Enter the Manufacturer's name or Federal Code, the part number

2.1.1.6 (Cont.)

and revision letter for all applicable changes to system components. This information can be obtained from the applicable drawing system control documents.

2.1.1.7 Maintenance Level (B)

Three levels of maintenance have been established. (Reference paragraph 2.0.1.2) Assignment of activities to those levels will define the appropriate level allocation of all maintenance support elements. A coded entry for each maintenance action will be selected from the levels information and entered.

2.1.1.8 Maintenance Location (C)

Enter in (C) the alpha-numeric identifier which indicates the location at which each maintenance operation is performed. The location code number and location names are as shown in paragraph 1.1.2.7.

2.1.1.9 Scheduled/Unscheduled (D)

An "S" (Scheduled) will be entered in Column D whenever the planned maintenance activities shown in the repair cycle columns (I) are those which are performed on a periodic basis to ensure the functional success of the equipment. A "U" (Unscheduled) will be entered to indicate that the maintenance activities are corrective in nature and precipitated by failure. Occasional preventive servicing may occur on a situation demand basis during the conduct of unscheduled maintenance.

2.1.1.10 Maintenance Activities (E)

Maintenance activities are those actions which will be required to perform the repair cycle or the servicing cycle for the item(s) being considered. These combined activities describe

the maintenance activities loop. The activities have been arranged on the maintenance activities analysis sheet in chronological order of performance. It may not be necessary to perform all of the activities listed in the repair cycle column heading.

a. Repair Cycle (E-10) - that action necessary to restore normal performance after failure or to preclude failure by scheduled replacement of parts. A repair cycle consists of all, or some, of the following activities which are chronologically arranged on the activities analysis sheets.

   (1) Localize - to diagnose the malfunction to the extent possible using only test, trouble shooting or inherent operational indication features built into the equipment, or, in some cases, by sensory check (sight, sound, smell).

   (2) Isolate - to diagnose the malfunction using accessory test equipment at designed test points. Some opening of the equipment may be necessary to gain access to the test points.

   (3) Disassemble - to remove the equipment from use or open it and remove any items necessary to make the failed item accessible.

   (4) Repair - to perform the operations necessary to remove the failed item, make disposition, acquire a replacement, and to position and install the replacement. The replacement item may be reinstalled if reworked to acceptable limits within the repair time allowed. This action will also include repair in place when authorized.

(5) Reassemble - to replace any items removed during the Disassemble function and to close the equipment and return it to service.

(6) Align - to calibrate and adjust as necessary to return the equipment to the required operating condition after performing previous repair activities.

(7) Verify - to ascertain, by use of self-test or other testing features, that the equipment has been restored to normal performance. This includes any system or equipment start-up function which may be necessary.

b. Servicing (E-20) - that action necessary, to replenish exhaustible commodities, on a scheduled basis to sustain predicted life of the unit. The commodities could be exhausted by contamination, evaporation, leak, or wear. Occasionally, Servicing may be performed on a situation demand basis during unscheduled maintenance activities.

(1) Prepare - to obtain the replenishment commodity in the proper form for use or application and to perform actions necessary (such as purge or clean) so that the equipment is ready to accept the commodity.

(2) Service - to introduce the commodity into the equipment in the prescribed manner and amount.

(3) Reactivate - to return the equipment to use and ascertain that equipment operation is normal.

c. Other - The categories of maintenance activities listed in a. and b. above will cover the majority of maintenance loops, however, certain loops may require OTHER activities such as "SAFE" or "REFURBISH". When OTHER

2.1.1.10 (Cont.)

activities are utilized, they will be assigned codes from 30 through 50 and the appropriate action verb entered in the REMARKS column.

d. An "X" is marked in each column for the selected function of the maintenance activity and becomes a Line Item for detailed analysis on the requirements analysis forms (see 2.2).

The maintenance activity codes which will be used for logistic loading EDP can be read directly from the sheet and are as follows:

ACTIVITY	CODE
REPAIR	10
Localize	11
Isolate	12
Disassemble	13
Repair	14
Reassemble	15
Align	16
Verify	17
SERVICING	20
Prepare	21
Service	22
Reactivate	23
OTHER	AS ASSIGNED (30 through 50)

2.1.1.11 Maintenance Activity Rate (F)

The entry will be made for each indenture level and it is either expressed as the reciprocal of Mean Time Between Failure (MTBF) or the elapsed time between scheduled maintenance activities. It will be expressed in occurrences per thousand hours. In the event that the item under consideration is cycle rather than time sensitive, the average number of

2.1.1.11 (Cont.)

cycles per unit time must be predicted and stated. This conversion is necessary so that a common time base can be used for system predictions. The conversion factors used for cycle limited items will be noted under REMARKS (L). The Maintenance Activity Rate is used to obtain the comparative maintainability index (see 2.1.1.13) as a measure of maintenance criticality, and for providing information for quantification of required logistics support elements. The Maintenance Activity Rate will be derived from equipment reliability, factored to the operating environment. This figure will be entered in the "U" (Unscheduled) column. The Maintenance Activity Rate will also take into account the projected equipment design life and/or time between servicing. The rate for such time or cycle dependent activities will be entered in the "S" (Scheduled) column.

2.1.1.12 Maintenance Activity Duration (G)

The entry will be the elapsed time to perform the repair or servicing being considered. In determining these time figures, the personnel task and/or equipment operating times allocated to each operation will be reviewed to determine those which can be performed concurrently with one another and will be shown in their proper series - parallel relationship to arrive at the total elapsed maintenance activity duration time requirement. It will be computed on Timed Flow sheets based on the Requirements Analysis Line Item/Opn. No. data. This time will be entered for each indentured item on the Maintenance Activities Analysis sheet and expressed in hours and decimals thereof. In addition to being used for time line analysis, it is combined with the Maintenance Activity Rate (F) to obtain the Comparative Maintainability Index (H). The maintenance activity duration will also be used as a criticality indicator against time-to-repair goals for critical points in the AVE Flow such as launch countdown.

2.1.1.13 Comparative Maintainability Index (H)

The product of (F) and (G) is to be entered in (H) and shows the relative criticality ranking of system or equipment components to be considered for maintainability action. The highest value should be considered as needing the most consideration. It will be used to evaluate inherent system/equipment maintainability and possible need for more detailed trade-off examination using procedures established in paragraph 1.3.

2.1.1.14 Provisioning Planning Area (J)

These entries, when used with the maintenance levels and locations, provide the maintenance requirements analysis source information for the selection and recommendation of spare parts in the proper quantities and at the proper locations to support the maintenance effort. Entries are made as follows:

(1) Logical Spare - Any part which when required by maintenance, will be procured and placed in stock to support the maintenance effort is a logical spare. A part must be capable of being physically removed from and replaced into its next higher assembly in order to be considered a logical spare. Some of the factors to be considered by the analyst in making logical spare recommendations are function criticality of the part, replaceability, environment, and wear susceptibility. The decision as to whether or not a part will be a logical spare will not be confused with quantity determinations. High design life and reliability could result in a low quantity determination. The analyst enters an "X" in this column if it is deemed that the item is a logical spare. The entry will indicate to spares provisioning personnel the requirement for a spare and that provisioning action for the item is necessary. When a component is not a logical spare, no entries will be made in the other columns under the PROVISIONING PLANNING DATA heading.

2.1.1.14 (Cont.)

(2) Reparable - An "X" is placed in this column if the Maintenance Requirements Analysis indicates that the item under consideration can be reworked to acceptable limits or restored to an operating condition by a repair cycle. A reparable item will be subject to maintenance requirements analysis to determine which components within the item are also logical spares for 2nd or 3rd level maintenance. It may generate requirements for MGE and facilities. This entry will be used as a factor in quantity determination of spares.

(3) Quantity/Assembly - Enter the number of times the spare part is used in the end item. The data is obtained from the applicable drawing and is used with MTBF and spares provisioning factors to determine spares quantities.

(4) Shelf Life - Shelf life identifies that period of time (quarter-years) an item may remain in spares stock in a serviceable condition. At the end of this time period the item must be withdrawn from serviceable status and dispositioned for overhaul, repair, salvage or scrap. Repair may involve replacement of cure-dated parts, functional test, renewed packaging and/or preservation. If Shelf Life exceeds 12 quarters, an entry of "IND" for indefinite is made. The material composition of the item being considered is obtained from the applicable drawing. This information will be used as a factor in determining storage location, quantity and replenishment spares data.

2.1.1.15 Maintenance Instructions (K)

This entry indicates the probable requirements for maintenance and repair instructions and will require further analysis to determine detailed instruction material. (See section 6.0 of this Plan Part II). An entry of "R" is made in (K) when the complexity or criticality of the line item task(s) requires written

2.1.1.15 (Cont.)

instructions. This determination is based upon the Personnel Information analysis portion of the Maintenance Requirements Analysis sheet. "N" is entered when written instructions are not required.

2.2 Requirements Analysis - Maintenance Activities

The performance and results of maintenance activities requirement analysis are similar to those stated in paragraph 1.2. The Requirements Analysis sheet is compatible for use in establishing both the logistics baseline and the maintenance requirements analysis. A sample sheet with its application and instructions for use are contained in paragraph 1.2. Figure 2.2-1 is a completed sample maintenance requirements analysis of the maintenance loop described by Figure 2.1-2. Technical requirements related to scheduled maintenance functions shall be delineated in sufficient detail so that thorough evaluation of the scheduled maintenance functions and tasks and their frequency can be accomplished. For unscheduled maintenance, the technical requirements for localize shall functionally identify the indication by which the malfunction is first detected. All technical requirements inherent in proceeding from the initial indication through localize and isolate to the malfunctioning component and through subsequent disassembly, repair reassembly, and verify, shall be listed. The maintenance loop described may re-enter the operations success path sequence at a point in time which requires repetition of operations which had been performed previously.

2.3 Trade Studies - Maintenance

Trade studies for maintenance will be conducted in the same manner as those which assist in establishing the logistic baseline (see 1.3). The Trade Study Comparison sheets are compatible for use in either case. Their application

2.3 (Cont.)

and instructions for use are contained in paragraph 1.3. An example trade study follows and its completed sample is shown as Figure 2.3-1.

2.3.1 Condition

The following example describes a condition that requires maintainability corrective action.

(a) The replacement of the propellant pressure transducer, which threads into a boss at bottom of the tank, requires off-loading of the propellant.

(b) Satisfactory operation of the transducer is critical to the vehicle launch.

(c) The time limits imposed by optimum launch sequence preclude replacement of transducers, as presently installed, during countdown.

2.3.1.1 Problem

How can the installation of the propellant pressure transducer be modified to permit replacement without off-loading of propellant?

2.3.1.2 Alternate Solutions

(a) Modify fittings such that the transducer senses pressure from an external tube that can be isolated from the propellant tank by means of a hand operated shut-off valve.

(b) Modify fittings such that removal of the transducer from the propellant tank automatically closes off the opening similar to a quick disconnect fitting.

2.3.1.3 Trade- Off Decision

Completion of the trade-off data sheets (Figure 2.3-1 Sheets 1 and 2) for proposal -1 and -2 provides average

2.3.1.3 (Cont.)

net desirability rating for each proposal. Proposal -2 with an average net desirability of -5.88 was judged to be unacceptable. Comparison of the average net desirability ratings determined that proposal -1 with an average net desirability rating of +10.14 will be selected as the solution to the maintainability problem.

2.4 End Item Requirements - Maintenance

Design criteria for system unique and standard maintenance equipment will be generated as shown in paragraph 1.4. The Design Criteria sheets and Standard Equipment Requirements sheets are compatible for use in both the logistics baseline and maintenance requirements analyses. Figures 2.4-1 and 2.4-2 are completed samples of sheets and are generated by the technical requirements shown in the completed sample Maintenance Requirements Analysis of paragraph 2.2.

2.5 Timed Flow Analysis - Maintenance

Maintenance Timed Flow Analysis is conducted in a manner similar to that described in paragraph 1.5. The Timed Flow sheets are compatible for use in either the logistic baseline or maintenance requirements analysis. A completed timed flow sample utilizing the information shown on the completed requirements analysis, Figure 2.2-1, is shown as Figure 2.5-1, sheets 1-8.

2.6 End Item Logistics Requirements Summary

An End Item Logistics Requirements Summary will be prepared to summarize the logistics resources and services identified by the logistics baseline and maintenance requirements analysis to support each contract end item used in the Apollo Program. Identified resources will include personnel skills, supporting facilities and equipment, spares, consumables, maintenance instructions and other supporting requirements. The summary will be prepared in two parts as follows.

2.6 (Cont.)

a. Part I will provide a summation of the salient conclusions reached during the maintenance analysis, including equipment description, and a summary of the logistics elements needed to support the subject equipment.

b. Part II will provide substantiation and recommendations for implementation and procurement of the support requirements outlined in Part I. Summaries will be prepared in a time frame which provides for their acquisition in consonance with program schedule requirements.

The following paragraphs describe Parts I and II summary information in detail. An illustrative sample End Item Logistics Requirements Summary is provided in Appendix G.

2.6.1 End Item Logistics Requirements Summary - Part I

Part I will, as a minimum, contain the following:

a. Equipment Identification

Provide a functional, physical and use description of the equipment for which logistics support is being provided. Include the identification of the point(s) on the Logistics Baseline at which the end item is used.

b. Logistics Plan

Provide the logistics plan for the equipment to include the following:

(1) Maintenance and Repair

Define the scheduled and unscheduled maintenance functions or actions, locations and gross performance times for first, second and third level maintenance and repair.

(2) Spares Requirements

Summarize the spares requirements in support of the subject end item of equipment in terms of PEN nomenclature, part number, level and the quantity

2.6.1 (Cont.)

to be provisioned for a population of one end item.

(3) Personnel Requirements Information

Summarize the personnel requirements to support the equipment in terms of type, skills and quantity necessary to operate and maintain the one end item.

(4) AGE/Facilities

Summarize the AGE/Facilities, by design criteria and/or standard equipment requirements reference number, required to support the equipment being analyzed.

(5) Operations and Maintenance Instructions

Provide a brief summary of the instructions needed to support the end item. Delineate by type, use location(s) and source data reference.

c. Special Logistic Considerations

Summarize those logistics considerations that warrant special attention by technical or management personnel to insure proper maintenance of the end item.

2.6.2 End Item Logistics Requirements Summary - Part II

Part II of the summary will state recommendations for design and/or acquisition of the logistics elements covered in Part I above to support the logistics Baseline. It will certify that spares, personnel, training, operations and maintenance instructions and AGE/Facilities as identified are available in inventory, are not available, or inventory resources may be utilized, if modified. Decisions to modify resources requirements will be based on economic trade study.

2.6.3 Updating

Provisions for continuous updating will be made to allow for inclusion of new or revised logistics elements requirements.

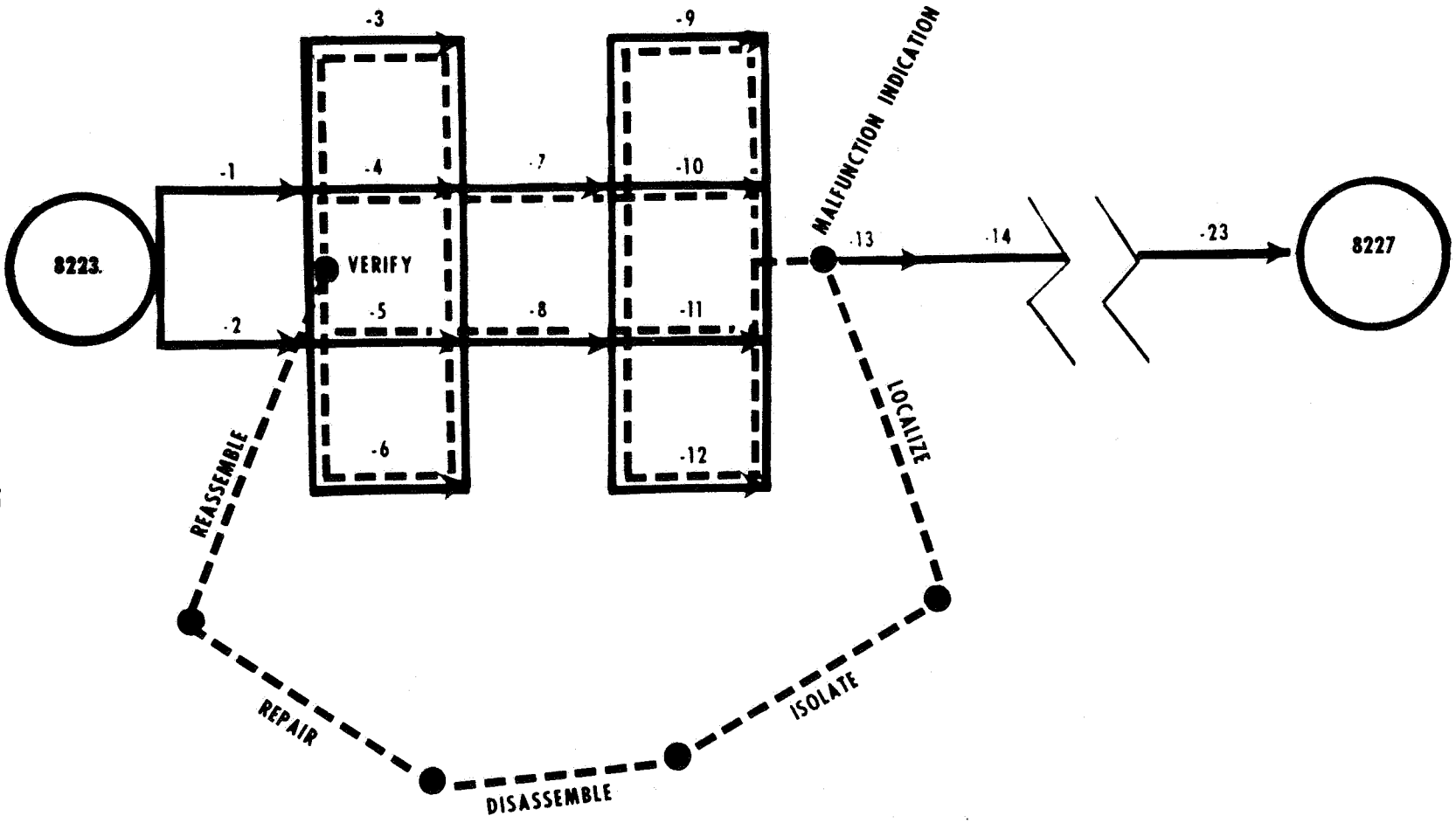


FIGURE 2.0-1: MAINTENANCE ACTIVITIES LOOP RELATIONSHIP TO AVE OPERATIONS FLOW

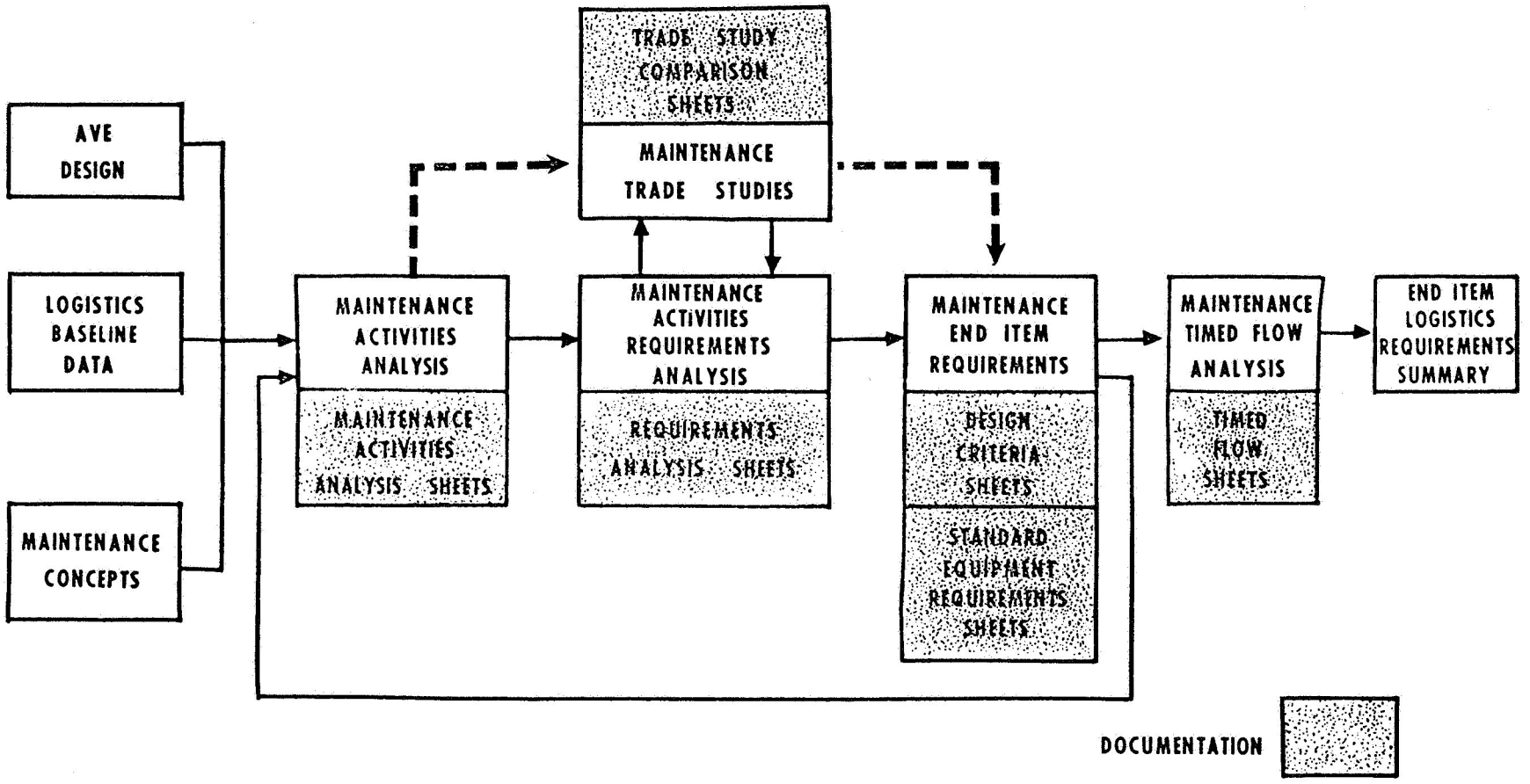


FIGURE 2.0-2; MAINTENANCE REQUIREMENTS ANALYSIS FUNCTIONS AND RELATED DOCUMENTATION

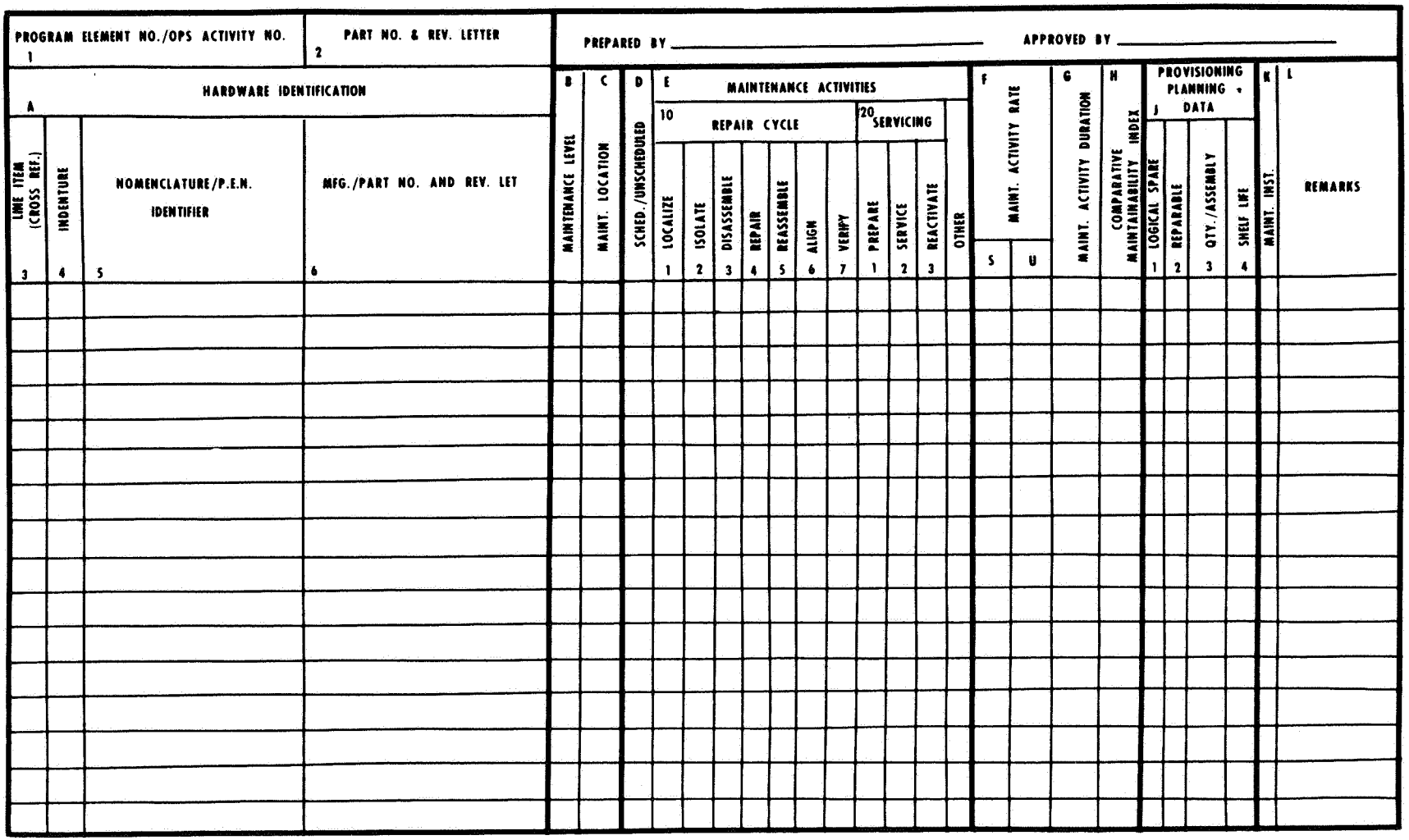


FIGURE 2.1-1; SAMPLE MAINTENANCE ACTIVITIES ANALYSIS SHEET

PROGRAM ELEMENT NO./OPS ACTIVITY NO. 1: 8223.8227-13 | PART NO. & REV. LETTER 2 | PREPARED BY _____ | APPROVED BY _____

A HARDWARE IDENTIFICATION				B	C	D	E MAINTENANCE ACTIVITIES											F		G	H	J PROVISIONING PLANNING DATA				K	L
							10 REPAIR CYCLE							20 SERVICING													
LINE ITEM (CROSS REF.) 3	INDENTURE 4	NOMENCLATURE/P.E.N. IDENTIFIER 5	MFG./PART NO. AND REV. LET 6	MAINTENANCE LEVEL	MAINT. LOCATION	SCHED./UNSCHEDULED	LOCALIZE 1	ISOLATE 2	DISASSEMBLE 3	REPAIR 4	REASSEMBLE 5	ALIGN 6	VERIFY 7	PREPARE 1	SERVICE 2	REACTIVATE 3	OTHER	MAINT. ACTIVITY RATE S	MAINT. ACTIVITY RATE U	MAINT. ACTIVITY DURATION	COMPARATIVE MAINTAINABILITY INDEX	LOGICAL SPARE 1	REPARABLE 2	QTY./ASSEMBLY 3	SHELF LIFE 4	MAINT. INST.	REMARKS
	1	Monitor for Leakage Fuel Fill																	.061	2.16	.132						
1		and Drain Line and Fuel Fill		1	D2	U	X													.51						R	
2		and Drain Valve (C128)		1	D2	U		X												.44						R	
				1	D2	U			X						(SEE LOWER INDENTURE)												
				1	D2	U				X					(SEE LOWER INDENTURE)												
				1	D2	U					X				(SEE LOWER INDENTURE)												
3				1	D2	U							X							.5						R	
	6	Fuel Fill and Drain Valve	NAA																.014	2.71	.038	X	X	1	12		
		(C128)	P/N V7-480450	1	D2	U	X													.51							
				1	D2	U		X												.3							
4				1	D2	U			X											.5						R	
5				1	D2	U				X										.8						R	
6				1	D2	U					X									.6						R	
				1	D2	U							X							.5							
	6	Wiring																	.013	1.91	.025		X				
				1	D2	U	X													.51							

MAINTENANCE ACTIVITIES ANALYSIS

SHEET 1 OF 11

CONDUCT FUNCTIONAL AND LEAK TEST FUEL TANK FILL AND DRAIN SYSTEM FUEL VENT AND RELIEF SYSTEM, FUEL RECIRCULATION SYSTEM AND FUEL

NOMENCLATURE FEED SYSTEM - S-II STAGE

PART NO. & REV. LTR. _____

P.E.N./OPS ACTIVITY NO. 8223.8227-13

FIGURE 2.1-2; SHEET 1, COMPLETED SAMPLE MAINTENANCE ACTIVITIES ANALYSIS SHEET

PROGRAM ELEMENT NO./OPS ACTIVITY NO. (1) 8223.8227-13 | PART NO. & REV. LETTER (2)

PREPARED BY _____ APPROVED BY _____

HARDWARE IDENTIFICATION (A)				B	C	D	E MAINTENANCE ACTIVITIES											F		G	H	PROVISIONING PLANNING DATA (J)				K	L
							10 REPAIR CYCLE							20 SERVICING				MAINT. ACTIVITY RATE									
LINE ITEM (CROSS REF.) (3)	INDENTURE (4)	NOMENCLATURE/P.E.N. IDENTIFIER (5)	MFG./PART NO. AND REV. LET (6)	MAINTENANCE LEVEL	MAINT. LOCATION	SCHED./UNSCHEDULED	LOCALIZE 1	ISOLATE 2	DISASSEMBLE 3	REPAIR 4	REASSEMBLE 5	ALIGN 6	VERIFY 7	PREPARE 1	SERVICE 2	REACTIVATE 3	OTHER	S	U	MAINT. ACTIVITY DURATION	COMPARATIVE MAINTAINABILITY INDEX	LOGICAL SPARE 1	REPARABLE 2	QTY./ASSEMBLY 3	SHELF LIFE 4	MAINT. INST.	REMARKS
7	6	Wiring (Continued)		1	D2	U		X												.6						R	
8				1	D2	U				X										.3						R	
				1	D2	U							X							.5							
	6	Quick Disconnect Connector	(TED)																.013	2.11	.027	X	X	1	12		
		Pneumatic Actuation (C303)		1	D2	U	X													.51							
				1	D2	U		X												.7							
9				1	D2	U			X											.1						R	
10				1	D2	U				X										.3						R	
11				1	D2	U					X									.1						R	
				1	D2	U							X							.5							
	6	Tubing																	.001	2.11			X				
				1	D2	U	X													.51							
12				1	D2	U		X												.8						R	
13				1	D2	U				X										.5						R	
				1	D2	U							X							.5							

MAINTENANCE ACTIVITIES ANALYSIS

SHEET 2 OF 11

NOMENCLATURE CONDUCT FUNCTIONAL AND LEAK TEST FUEL TANK FILL AND DRAIN SYSTEM, FUEL VENT AND RELIEF SYSTEM, FUEL RECIRCULATION SYSTEM AND FUEL FEED SYSTEM - S-II STAGE

PART NO. & REV. LTR. _____

P.E.N./OPS ACTIVITY NO. 8223.8227-13

FIGURE 2.1-2; SHEET 2, COMPLETED SAMPLE MAINTENANCE ACTIVITIES ANALYSIS SHEET

PROGRAM ELEMENT NO./OPS ACTIVITY NO. 1: 8223.8227-13 | PART NO. & REV. LETTER 2 | PREPARED BY _____ | APPROVED BY _____

A HARDWARE IDENTIFICATION				B	C	D	E MAINTENANCE ACTIVITIES											F		G	H	J PROVISIONING PLANNING DATA				K	L
							10 REPAIR CYCLE							20 SERVICING				MAINT. ACTIVITY RATE									
LINE ITEM (CROSS REF.) 3	INDENTURE 4	NOMENCLATURE/P.E.N. IDENTIFIER 5	MFG./PART NO. AND REV. LET 6	MAINTENANCE LEVEL	MAINT. LOCATION	SCHED/UNSCHEDULED	LOCALIZE 1	ISOLATE 2	DISASSEMBLE 3	REPAIR 4	REASSEMBLE 5	ALIGN 6	VERIFY 7	PREPARE 1	SERVICE 2	REACTIVATE 3	OTHER	S	U	MAINT. ACTIVITY DURATION	COMPARATIVE MAINTAINABILITY INDEX	LOGICAL SPARE 1	REPARABLE 2	QTY./ASSEMBLY 3	SHELF LIFE 4	MAINT. INST.	REMARKS
	6	Quick Connect Connector	NAA																.020	2.01	.04	X	X	1	12		
		(C139)	P/N ME1L4-0005-0003	1	D2	U	X													.51							
				1	D2	U		X												.3							
14				1	D2	U			X											.2						R	
15				1	D2	U				X										.6						R	
16				1	D2	U					X									.4						R	
				1	D2	U							X							.5							

MAINTENANCE ACTIVITIES ANALYSIS

SHEET 3 OF 11

CONDUCT FUNCTIONAL AND LEAK TEST FUEL TANK FILL AND DRAIN SYSTEM, FUEL VENT AND RELIEF SYSTEM, FUEL RECIRCULATION SYSTEM AND FUEL

NOMENCLATURE FEED SYSTEM - SII STAGE

PART NO. & REV. LTR. _____

P.E.N./OPS ACTIVITY NO. 8223.8227-13

FIGURE 2.1-2; SHEET 3, COMPLETED SAMPLE MAINTENANCE ACTIVITIES ANALYSIS SHEET

LINE ITEM/OP M NO. A	B TECHNICAL REQUIREMENTS	C EQUIPMENT/FACILITY IDENTIFICATION		D PERSONNEL INFORMATION					
		P.E.N. D.C. S.E.R. NO. 1	EQUIPMENT/ FACILITY NOMENCLATURE 2	PERSONNEL TASKS 1	PERSONNEL REQUIREMENTS TYPE 2	ELAPSED TIME 3	QUANTITY 4	TASK PROF LEVEL 5	PERF. CRIT. 6
1	**Localize** Monitor for Leakage Fuel Fill and Drain Line and Fuel Fill and Drain Valve (C120). A. Monitor for closed indication of the Fill and Drain Valve at operations control, utilizing 28 VDC signals from vehicle. B. Monitor for internal leakage rate (grester than 300 SCIM) on the downstream side of the Fill and Drain Valve at operations control. C. Provide power to the following locations: (1) Pneumatic Supply Control Pressure (GHe) 750 ± 50 PSIG at coupling (C303). (2) 28 VDC ± 4/6 supply to Bus + 2D40. (3) Controlled Pressure (C to 36 PSIA) of GHe Supply to pressurize LH2 tank (3516 cu. ft.) in TBD minutes through coupling (C139).			1. **Localize** AAA. Indication of excessive leakage and Fill and Drain Valve "CLOSED" light "ON" AAB. Indication of excessive leakage and Fill and Drain Valve "CLOSED" light "OFF". a. Read indicator_____on_____for leakage rate on the Fill and Drain System. b. Check "CLOSED" light on _____for Fill Drain Valve indication and proceed to Line Item 2.a.	201 202 202 201	 .51 .50 .01	1 1 1 1	111 221 221 111	 C B C

REQUIREMENTS ANALYSIS SHEET ORIGINAL DATE _____ PREPARED BY _____ PART NO. & REV. LTR. _____

REVISION DATE _____ P.E.N./OPS ACTIVITY NO. 8223.8227-13

SHEET 4 OF 11

FIGURE 2.2-1; SHEET 1, COMPLETED SAMPLE REQUIREMENTS ANALYSIS SHEET

LINE ITEM/OP'N NO. A	B TECHNICAL REQUIREMENTS	C EQUIPMENT/FACILITY IDENTIFICATION P.E.N. D.C. S.E.R. NO. 1	EQUIPMENT/FACILITY NOMENCLATURE 2	D PERSONNEL INFORMATION PERSONNEL TASKS 1	PERSONNEL REQUIREMENTS TYPE 2	ELAPSED TIME 3	QUANTITY 4	TASK PROF LEVEL 5	PERF. CRIT. 6
2	Isolate			2. Isolate	102 201 202 202	 .70	1 1 1 1	112 112 111 222	
	A. Portable device to measure voltage 28 + 4 - 8 VDC, ± 3% accuracy.	FC 6625	Multimeter	Fill and Drain System					
	B. Portable device to measure resistances of 0-1 meg ohms, ± 3% accuracy.	FC 6625	Multimeter	a. Check 28 Volt input to solenoid of Fill and Drain Valve using Multimeter, if incorrect proceed to continuity check wiring Line Item 7 for further isolation. If correct and Fill and Drain Valve indication is as follows: (1) "CLOSED" proceed to Step g. (2) Other than closed proceed to Step b.	102	.18	1	112	C
	C. Measure pneumatic pressure 750 ± 50 PSI within ± 5% accuracy. Device to be inserted into pneumatic lines.	FSN 6685-682-4543 or equivalent Roto bin stock	Pressure Gage						
	D. Same as Line Item 1.c.			b. Disable pneumatic input and bleed off pressure.	202	.10	1	111	C
	E. Apparatus to detect helium leakage (portable).	NAA Model No. A7-4 P/N G7-82004	Helium Leak Detector	c. Disconnect pneumatic input line to valve.	201	.08	1	112	C
				d. Connect pneumatic pressure monitor (TBD) to input line.	201	.08	1	112	C
	F. Gain access to work area located on stage exterior at S-II station 341.0 between fin A and position II.			e. Enable pneumatic input and monitor pressure, if correct proceed to Line Item 4.	202	.10	1	111	C
	G. Provide a Leak Detection Solution for detecting GN_2 leakage.			f. Check for leakage on pneumatic input line. If leakage is detected proceed to Line Item 12, if no leakage is detected proceed to Line Item 9.	201	.16	1	112	C
				g. Use helium leakage detection apparatus for He leakage around CQD (C139). If leakage is detected proceed to Line Item 14. If no leakage is detected proceed to Line Item 4.	202	.10	1	222	C
3	Verify Same as Activity 8223.8227-3 through -13.			3. Verify Proceed to Activity 8223.8227 and perform -3 through -13 operations.	202	.50	1	221	B

REQUIREMENTS ANALYSIS SHEET ORIGINAL DATE _____ PREPARED BY _____ PART NO. & REV. LTR. _____

REVISION DATE _____ P.E.N./OPS ACTIVITY NO. 8223.8227-13

SHEET 5 OF 11

FIGURE 2.2-1; SHEET 2, COMPLETED SAMPLE REQUIREMENTS ANALYSIS SHEET

LINE ITEM / OPN NO.	TECHNICAL REQUIREMENTS	EQUIPMENT / FACILITY IDENTIFICATION		PERSONNEL INFORMATION					
		P.E.N. D.C. S.E.R. NO.	EQUIPMENT / FACILITY NOMENCLATURE	PERSONNEL TASKS	PERSONNEL REQUIREMENTS				
					TYPE	ELAPSED TIME	QUANTITY	TASK PROF LEVEL	PERF CRIT
A	B	1	2	1	2	3	4	5	6
4	LH_2 Fill and Drain Valve (C128) Disassemble A. Gain access to fill and drain valve located on stage exterior at S-II station 341.0 between fin A and position II. B. Protect the valve insulation against damage while maintenance is being performed on the valve. C. Protect the coupling against damage.			4. Disassemble	142 201 202 401	.45	1 1 1 1	121 112 222 212	B
				a. Deactivate electrical and pneumatic.	142	.06	1	121	B
				b. Disconnect LH_2 fill and drain quick disconnect coupling umbilical.	202	.08	1	112	B
				c. Prepare work area at valve location.	201	.09	1	112	B
				d. Remove insulation from valve and place in a protective area. (TBD)	201	.06	1	112	B
				e. Obtain replacement valve and flange seal.	401	.15	1	212	B
				f. Remove LH_2 fill and drain disconnect coupling (C139). (Identical to Line Item 14). Place coupling in a protective area.	201 202	.22	1 1	112 222	B
5	Repair Protect open connectors and ports.	FSC 9330	Plastic Sheet	5. Repair	142 201 102	.77	1 1 1	111 112 222	C
				a. Disconnect electrical and plumbing connectors from valve.	202 142	.06	1 1	112 111	B
				b. Remove the attaching bolts and washers.	201 202	.24	1 1	112 222	B
				c. Remove the valve and flange seal.	201	.08	1	112	B
				d. Installation is the reverse of removal.	201 202	.39	1 1	112 222	C

REQUIREMENTS ANALYSIS SHEET ORIGINAL DATE _____ PREPARED BY _____ PART NO. & REV. LTR. _____

REVISION DATE _____ P.E.N./OPS ACTIVITY NO. 8223.8227-13

SHEET 6 OF 11

FIGURE 2.2-1; SHEET 3, COMPLETED SAMPLE REQUIREMENTS ANALYSIS SHEET

A LINE ITEM/OP'N NO.	B TECHNICAL REQUIREMENTS	C EQUIPMENT/FACILITY IDENTIFICATION		D PERSONNEL INFORMATION					
		P.E.N. D.C. S.E.R. NO. 1	EQUIPMENT/ FACILITY NOMENCLATURE 2	PERSONNEL TASKS 1	PERSONNEL REQUIREMENTS				
					TYPE 2	ELAPSED TIME 3	QUANTITY 4	TASK PROF LEVEL 5	PERF. CRIT. 6
6	Reassemble			6. Reassemble	142 201 202 401	.59	1 1 1 1	112 112 212 212	B
				a. Install LH_2 fill and drain quick disconnect coupling. (Identical to Line Item 16)	202	.31	2	112	C
				b. Install insulation on the valve.	201	.08	1	112	C
				c. Transport removed valve to disposition area.	401	.15	1	212	B
				d. Clean and vacate the area.	201	.13	1	112	C
				e. Connect LH_2 fill and drain umbilical quick disconnect coupling.	201	.08	1	112	C
				f. Reactivate electrical and pneumatic.	202 142	.06	1 1	212 112	B

REQUIREMENTS ANALYSIS SHEET ORIGINAL DATE _____ PREPARED BY _____ PART NO. & REV. LTR. _____

REVISION DATE _____ P.E.N./OPS ACTIVITY NO. 8223.8227-13

SHEET 7 OF 11

FIGURE 2.2-1: SHEET 4, COMPLETED SAMPLE REQUIREMENTS ANALYSIS SHEET

LINE ITEM/OPN NO A	B TECHNICAL REQUIREMENTS	C EQUIPMENT/FACILITY IDENTIFICATION: PEN DC S.E.R. NO. 1	C EQUIPMENT/FACILITY NOMENCLATURE 2	D PERSONNEL INFORMATION: PERSONNEL TASKS 1	PERSONNEL REQUIREMENTS: TYPE 2	ELAPSED TIME 3	QUANTITY 4	TASK PROF LEVEL 5	PERF. CRIT. 6
7	Wiring — Isolate A. Portable device to measure resistances of 0-1 meg ohm, ± 3% accuracy. B. Adapters for plugs to continuity check between the following points: (1) Bus "+ 2D40" to 206W18P5. (2) Bus "+ 2D40" to 206W18P7. (3) Bus "2DCOM" to 206W18P4. (4) (206A8J1/11) to 206W18P5. (5) (206A8J1/32) to 206W18P4. (6) (206A8J1/10) to 206W18P7. C. Gain access to Bus "+ 2D40", Bus "2DCOM" and Fill and Drain Valve electrical plugs.			7. Isolate	142 201	.42	1 1	222 212	C
				a. De-energize bus "+ 2D40".	142	.06	1	222	B
				b. Continuity check wiring to find fault.	142 201	.36	1 1	222 212	C
8	Repair TBD			8. Repair Repair as needed to correct failure.	142 201 142 201	.25	1 1	222 212 222 212	C

REQUIREMENTS ANALYSIS SHEET ORIGINAL DATE _____ PREPARED BY _____ PART NO. & REV. LTR. _____

REVISION DATE _____ P.E.N./OPS ACTIVITY NO. 8223.8227-13

SHEET 8 OF 11

FIGURE 2.2-1; SHEET 5, COMPLETED SAMPLE REQUIREMENTS ANALYSIS SHEET

LINE ITEM/OP'N NO. A	B TECHNICAL REQUIREMENTS	C EQUIPMENT/FACILITY IDENTIFICATION: P.E.N. D.C. S.E.R. NO. 1	C EQUIPMENT/FACILITY NOMENCLATURE 2	D PERSONNEL INFORMATION: PERSONNEL TASKS 1	PERSONNEL REQUIREMENTS: TYPE 2	ELAPSED TIME 3	QUANTITY 4	TASK PROF LEVEL 5	PERF. CRIT. 6
9	Quick Disconnect Coupling, Pneumatic Actuation (C303)				202 201 401	 .16	1 1 1	212 212 212	 B
	Disassemble			9. Disassemble					
	A. Gain access to coupling located at the S-II intermediate umbilical location (TBD) on the exterior and interior of the stage.			a. Deactivate pneumatic and disconnect the coupling umbilical.	202	.06	1	212	
				b. Prepare work area at coupling interior and exterior locations.	201	.15	1	212	B
	B. Illuminate the aft compartment area.			c. Obtain replacement coupling.	401			212	
10	Repair			10. Repair	202 142	 .26	1 1	222 222	 C
	Protect open connector.	FSC 9330	Plastic Sheet	a. Disconnect plumbing connector inside the stage.	202	.02	1	222	B
				b. Remove attaching bolts and washers from outside the stage.	202	.08	1	222	B
				c. Remove coupling from inside the stage.	202	.03	1	222	B
				d. Installation is the reverse of removal.	202 142	.15	1 1	222 222	C
11	Reassemble			11. Reassemble	101 102 401	 .18	1 1 1	112 212 212	 B
				a. Connect the coupling umbilical and reactivate pneumatic.	202	.06	1	212	B
				b. Clean and vacate the area.	201	.18	1	112	B
				c. Transport the removed coupling to disposition area.	401	.15	1	212	B

REQUIREMENTS ANALYSIS SHEET ORIGINAL DATE _____ PREPARED BY _____ PART NO. & REV. LTR. _____

REVISION DATE _____ P.E.N./OPS ACTIVITY NO. 8223.8227-13

SHEET 9 OF 11

FIGURE 2.2-1; SHEET 6, COMPLETED SAMPLE REQUIREMENTS ANALYSIS SHEET

LINE ITEM OPN NO (A)	B TECHNICAL REQUIREMENTS	C EQUIPMENT/FACILITY IDENTIFICATION		D PERSONNEL INFORMATION					
		P.E.N. D.C. S.E.R. NO. (1)	EQUIPMENT/FACILITY NOMENCLATURE (2)	PERSONNEL TASKS (1)	PERSONNEL REQUIREMENTS TYPE (2)	ELAPSED TIME (3)	QUANTITY (4)	TASK PROF LEVEL (5)	PERF. CRIT. (6)
12	Tubing — Isolate A. Measure pneumatic pressure (750 ± 50 psi) within ± 5% accuracy. Device to be inserted into pneumatic lines. B. Tubing lines to be checked are between the following terminal points: C303 to C128 C. Gain access to the above tubing.			12. Isolate	202 201	.70	1 1	222 212	C
				a. Disable pneumatic input and bleed off pressure. Remove pneumatic pressure monitor from input line and reconnect input line to valve.	202 201	.26	1 1	222 212	C
				b. Trace input line back until a connection is found so as to insert pneumatic pressure monitor (TBD) into line. Disconnect connection and insert pneumatic pressure monitor into line.	202 201	.36	1 1	222 212	C
				c. Enable pneumatic input and monitor pressure. If incorrect repeat steps a, b, and c until trouble is found. When trouble is found, proceed to Repair - Tubing, Line Item 13.	202	.10	1	222	C
13	Repair TBD			13. Repair	202 212	.50	1 1	222 212	C
				Repair/replace tubing as required.	202 201	.50	1 1	222 212	C

REQUIREMENTS ANALYSIS SHEET ORIGINAL DATE _____ PREPARED BY _____ PART NO. & REV. LTR. _____

REVISION DATE _____ P.E.N./OPS ACTIVITY NO. 8223.8227-13

SHEET 10 OF 11

FIGURE 2.2-1; SHEET 7, COMPLETED SAMPLE REQUIREMENTS ANALYSIS SHEET

LINE ITEM/OP'N NO. A	B TECHNICAL REQUIREMENTS	C EQUIPMENT/FACILITY IDENTIFICATION		D PERSONNEL INFORMATION					
		P.E.N. D.C. S.E.R. NO.	EQUIPMENT/ FACILITY NOMENCLATURE 2	PERSONNEL TASKS 1	PERSONNEL REQUIREMENTS TYPE 2	ELAPSED TIME 3	QUANTITY 4	TASK PROF LEVEL 5	PERF. CRIT. 6
14	Quick Disconnect Coupling, LH_2 Fill and Drain (C139) Disassemble Identical to Line Item 4.			14. Disassemble Identical to Line Item 4.a. to 4.3.	201 202 401	.23	1 1 1	112 222 212	B
15	Repair			15. Repair	202 201	.57	1 1	222 212	C
				a. Remove attaching bolts and washers.		.18	2		B
				b. Remove and replace the coupling and flange seal.		.08	2		B
				c. Installation is the reverse of removal.		.31	2		C
16	Reassemble			16. Reassemble The tasks are identical to Line Item 6.b to 6.f.	202 201	.39	1 1	212 112	C

REQUIREMENTS ANALYSIS SHEET ORIGINAL DATE _____ PREPARED BY _____ PART NO. & REV. LTR. _____

REVISION DATE _____ P.E.N./OPS ACTIVITY NO. 8223.8227-13

SHEET 11 OF 11

FIGURE 2.2-1; SHEET 8. COMPLETED SAMPLE REQUIREMENTS ANALYSIS SHEET

END ITEM S-1C
SYSTEM Fuel Delivery
PEN/OPS ACTIVITY NO. XXXXXXXXX
EFFECTIVITY 501 & on

TRADE STUDY COMPARISON SHEET

TRADE-OFF NO: 123-1 Sh 1
DATE: April 17, 1965

PROPOSED SOLUTION Modify fittings so that transducer senses pressure from an external tube that can be isolated from the propellant tank by a manual shutoff valve.

PARAMETERS	EFFECT OF PROPOSED SOLUTION	RELATIVE WEIGHTING	DESIRABILITY RATING	WEIGHTED DESIRABILITY RATING
PERFORMANCE	No effect on system performance.	5	0	0
SCHEDULES	Design and manufacture concurrent with vehicle fabrication. No production delay.	5	0	0
SAFETY	Propellant tank not drained. Slight decrease in safety if manual valve is defective.	5	-5	-25
RELIABILITY	Additional valve safetied in open position has only slight effect on reliability.	4	-5	-20
MAINTENANCE TIME	Elapsed replacement time 0.5 hours.	5	+70	+350
MAINTENANCE COST	Two men - 1.0 manhours.	3	+50	+150
SUPPORT REQUIREMENTS	Stocking of manual valve and standard fittings. No additional equipment or special tools.	2	-20	-40
			TOTALS	

AVERAGE NET DESIRABILITY RATING _____

RELATIVE RANK _____

FIGURE 2.3-1; SHEET 1. COMPLETED SAMPLE TRADE STUDY COMPARISON SHEET

END ITEM S-1C
SYSTEM Fuel Delivery
PEN/OPS ACTIVITY NO. XXXXXXXXX
EFFECTIVITY 501 & on

TRADE STUDY COMPARISON SHEET

TRADE-OFF NO: 123-1 Sh 2
DATE: April 17, 1965

PROPOSED SOLUTION Modify fittings so that transducer senses pressure from an external tube that can be isolated from the propellant tank by a manual shutoff valve.

PARAMETERS	EFFECT OF PROPOSED SOLUTION	RELATIVE WEIGHTING	DESIRABILITY RATING	WEIGHTED DESIRABILITY RATING
FABRICATION COSTS	Manual valve and fittings. $150 per vehicle. Effect negligible.	1	-10	-10
HUMAN FACTORS	No effect.	1	0	0
WEIGHT	Additional weight 2.3 pounds.	3	-20	-60
		34	TOTALS	+345

AVERAGE NET DESIRABILITY RATING +10.14

RELATIVE RANK 1

FIGURE 2.3-1; SHEET 2. COMPLETED SAMPLE TRADE STUDY COMPARISON SHEET

END ITEM S-1C
SYSTEM Fuel Delivery
PEN/OPS ACTIVITY NO. XXXXXXXXX
EFFECTIVITY 501 & on

TRADE STUDY COMPARISON SHEET

TRADE-OFF NO: 123-2 Sh 1
DATE: April 17, 1965

PROPOSED SOLUTION Modify fitting so that removal of the transducer from the propellant tank automatically closes off the opening similar to a quick disconnect fitting.

PARAMETERS	EFFECT OF PROPOSED SOLUTION	RELATIVE WEIGHTING	DESIRABILITY RATING	WEIGHTED DESIRABILITY RATING
PERFORMANCE	No effect on system performance.	5	0	0
SCHEDULES	Requires modification of tank bulkhead boss; design and qualification of transducer housing and mounting adapter. Three week production delay.	5	-60	-300
SAFETY	Propellant tank not drained. Automatic shutoff valve reduces safety. Leakage of valve can be detected only after removal of transducer.	5	-40	-200
RELIABILITY	Additional automatic valve and increased possibility of leakage decreases reliability.	4	-20	-80
MAINTENANCE TIME	Elapsed replacement time 0.4 hours.	5	+80	+400
MAINTENANCE COST	Two men - 0.8 hours.	3	+60	+180
			TOTALS	

AVERAGE NET DESIRABILITY RATING _____

RELATIVE RANK _____

FIGURE 2.3-1; SHEET 3, COMPLETED SAMPLE TRADE STUDY COMPARISON SHEET

END ITEM S-1C
SYSTEM Fuel Delivery
PEN/OPS ACTIVITY NO. XXXXXXXXX
EFFECTIVITY 501 & on

TRADE STUDY COMPARISON SHEET

TRADE-OFF NO: 123-2 Sh 2
DATE: April 17, 1965

PROPOSED SOLUTION Modify fitting so that removal of the transducer from the propellant tank automatically closes off the opening similar to a quick disconnect fitting.

PARAMETERS	EFFECT OF PROPOSED SOLUTION	RELATIVE WEIGHTING	DESIRABILITY RATING	WEIGHTED DESIRABILITY RATING
SUPPORT REQUIREMENTS	Special wrench for rotating transducer housing required.	2	-30	-60
FABRICATION COSTS	Modification of tank bulkhead boss and manufacture of mounting adapter $1500.00 per vehicle.	1	-20	-20
HUMAN FACTOR	No effect.	1	0	0
WEIGHT	Additional weight 4.1 pounds.	3	-60	-120
		34	TOTALS	-200

AVERAGE NET DESIRABILITY RATING -5.88

RELATIVE RANK 2

FIGURE 2.3-1; SHEET 4, COMPLETED SAMPLE TRADE STUDY COMPARISON SHEET

DESIGN CRITERIA SHEET

A DC 1009 (N)

B REVISIONS

1 SYM	2 DESCRIPTION	3 DATE	4 APPROVAL

C REFERENCE	D REQUIREMENTS
Maintenance Analysis 8223.8227-13 Sheet 8 Line Item 7.B	General The Connector Test Adapter Kit shall provide the means to gain access to multiple pin electrical connectors of S-II Stage installed equipment, electrical cables and busses, for performance of continuity tests in accordance with MSFC-SPEC-75M50497. 1.0 Performance The Connector Test Adapter Kit shall have the capability to perform as a test accessory during MILA High Bay and Pad maintenance of the S-II Fuel Fill and Drain System electrical subsystem. 1.1 Functional Characteristics The Connector Test Adapter Kit shall provide remote electrical access to stage electrical connectors during resistance and continuity testing, to prevent test probe damage to connector terminals, without impairing testing efficiency. 1.2 Operability 1.2.1 Reliability: This item shall be designed in accordance with the reliability considerations included in paragraph 3.3.1 of "General Criteria for Saturn V MGSE". 1.2.2 Maintainability: This item shall be designed for minimum maintenance. It shall be capable of installation on equipment under test within 10 minutes. 1.2.3 Useful Life: 6 years 1.2.4 Natural Environment: KSC Ambient, T=0°-125°F, RH-100% max.

ORIGINATOR CONTRACTOR E Contractor	NOMENCLATURE KIT, ADAPTER, CONNECTOR TEST N	GEORGE C. MARSHALL SPACE FLIGHT CENTER National Aeronautics and Space Administration
ORIGINAL DATE F May 6, 1965		NASA TECH ORGN. RESP S R-P&VE-VM
ENGINEER G / CHECKED H	TYPE MGE O	PROJECT SYSTEM DESIGNATION Saturn V/S-II Stage T
APPROVED J / APPROVED K	CEI CATEGORY PRIME P	PROGRAM ELEMENT NO (TBD) U
SUBMITTED L	CEI CRITICAL CODE NO CP-61365 Q	DETAIL SPEC NO. (TBD) V
APPROVED M	MFG MODEL PART NO (TBD) R	SHEET 1 OF 2 W

FIGURE 2.4-1: SHEET 1. COMPLETED SAMPLE DESIGN CRITERIA SHEET

DESIGN CRITERIA SHEET (cont.)	DC 1009 (N)

C REFERENCE	D REQUIREMENTS
	1.2.5 Transportability: Suitcase kit. 1.2.6 Human Performance: No critical skills involved. 1.2.7 Safety: Kit shall be designed in accordance with Paragraph 3.5, NPC 250-1. 1.2.8 Induced Environment: Not applicable. 2.0 CEI Definition 2.1 Interface Requirements: Adapters included in kit shall adapt to and be compatible with the following S-II Stage electrical test points: 1. Bus "+2D40" to 206W18p5 2. Bus "+2D40" to 206W18p7 3. Bus "2D COM" to 206W18p4 4. (206A8J1/11) to 206W18p5 5. (206A8J1/32) to 206W18p4 6. (206A8J1/10) to 206W18p7 2.2 Component Identification: No specific requirements. 2.3 Technical Manuals: Data shall be furnished for Operations and Maintenance Manual development. 2.4 Design and Construction 2.4.1 General Design Features: The kit shall provide the means to gain access, by physical and electrical mating connection to the S-II test points defined by paragraph 2.1 of this Design Criteria. 2.4.2 Selection of Specifications and Standards: Selection shall be made from MSFC approved Federal Agency Specifications and Standards. 2.4.3 Materials, Parts, and Processes: Shall be at discretion of supplier provided compatibility with performance requirements of this Design Criteria are maintained. 2.4.4 Standard and Commercial Parts: AN, modified AN, MS or AND standard parts shall be used whenever applicable. 2.4.5 Moisture and Fungus Resistance: Kit shall resist environment per Specification MIL-E-5272C. 2.4.6 Corrosion of Metal Parts: Kit shall resist salt spray environment per Specification, MIL-E-5272C. 2.4.7 Interchangeability and Replaceability: Kit shall be assigned a specific part number. All replacement parts shall be physically and functionally interchangeable. 2.4.8 Workmanship: Kit shall be fabricated in accordance with requirements of NHB 5300.1. 2.4.9 Electromagnetic Interference: Kit adapters and interconnect cables shall be in accordance with requirements of Specification MIL-I-6181D. 2.4.10 Identification and Marking: Kit shall be identified and marked in accordance with MIL-STD-130B. SHEET 2 OF 2

FIGURE 2.4-1; SHEET 2, COMPLETED SAMPLE DESIGN CRITERIA SHEET

STANDARD EQUIPMENT REQUIREMENTS	FEDERAL CLASS CODE	FEDERAL ITEM IDENT NUMBER
	6685	682-4543
Nomenclature: GUAGE, PRESSURE	**P/N:** H85-50	
	Mfr. Code: 28066	
P.E.N. TBD		

Location	ML1	ML2	ML3	ML4	VAB High Bay	VAB Low Bay	LCC	Support Shops	Other Areas
Quantity	TBD				TBD			TBD	

Item Description/Remarks:

1. Pneumatic pressure guage, 0 - 1000 psi ± 5% accuracy from 700 to 800 psi, 8½" dial.
2. Recommend allocation to location (F).
3. CEI is an Identification Item.

Technical Requirement Origin	Technical Requirement
Maintenance Analysis 8223.8227-13	Measure pneumatic pressure 750 ± 50 psi within 5% accuracy. Device to be inserted into pneumatic lines using adapter (see SER TBD).
R.A. Sheet 5 Line Item 2C	Use: To monitor pneumatic pressure to fill valve input.

FIGURE 2.4-2; COMPLETED SAMPLE STANDARD EQUIPMENT REQUIREMENTS SHEET

~~LOGISTICS BASELINE~~
MAINTENANCE REQUIREMENTS > TIMED FLOW SHEET

PEN/OPS ACTIVITY NO.	TYPE OF MAINTENANCE		PREPARED BY	APPROVED BY
8223. 8227-13	UNSCHEDULED REPAIR			
CROSS REFERENCE	LOCATION	ACTIVITIES/OPERATIONS/TASKS		
Sheet 1 Line 1	D2	LOCALIZE		
Sheet 1 Line 2	D2	ISOLATE, Mean Time		
Sheet 1	D2	(See Lower Indenture), Mean Time		
Sheet 5 Line 3	D2	VERIFY		

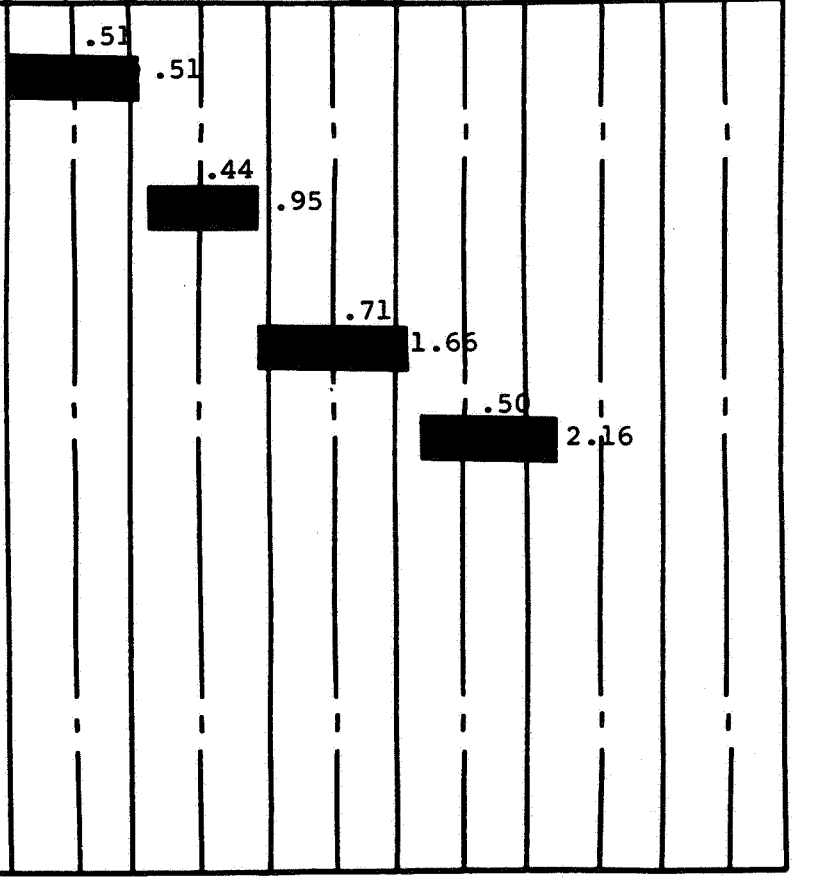


FIGURE 2.5-1: SHEET 1, COMPLETED SAMPLE TIMED FLOW ANALYSIS

~~LOGISTICS BASELINE~~
MAINTENANCE REQUIREMENTS > TIMED FLOW SHEET

PEN/OPS ACTIVITY NO.	TYPE OF MAINTENANCE		PREPARED BY	APPROVED BY
8223. 8227-13	UNSCHEDULED REPAIR			
CROSS REFERENCE	**LOCATION**	**ACTIVITIES/OPERATIONS/TASKS**		
Sheet 4 Line 1	D2	LOCALIZE		
		a. Read indicator for leakage rate.		
		b. Check "CLOSED" light.		
Sheet 5 Line 2	D2	ISOLATE		
		a. Check 28 volt input.		
		b. Disable pneumatic input.		
		c. Disconnect pneumatic line.		
		d. Connect pressure monitor.		
		e. Enable pneumatic input. Check pressure.		
		f. Check for pneumatic input leakage.		
		g. Use helium leak detector.		

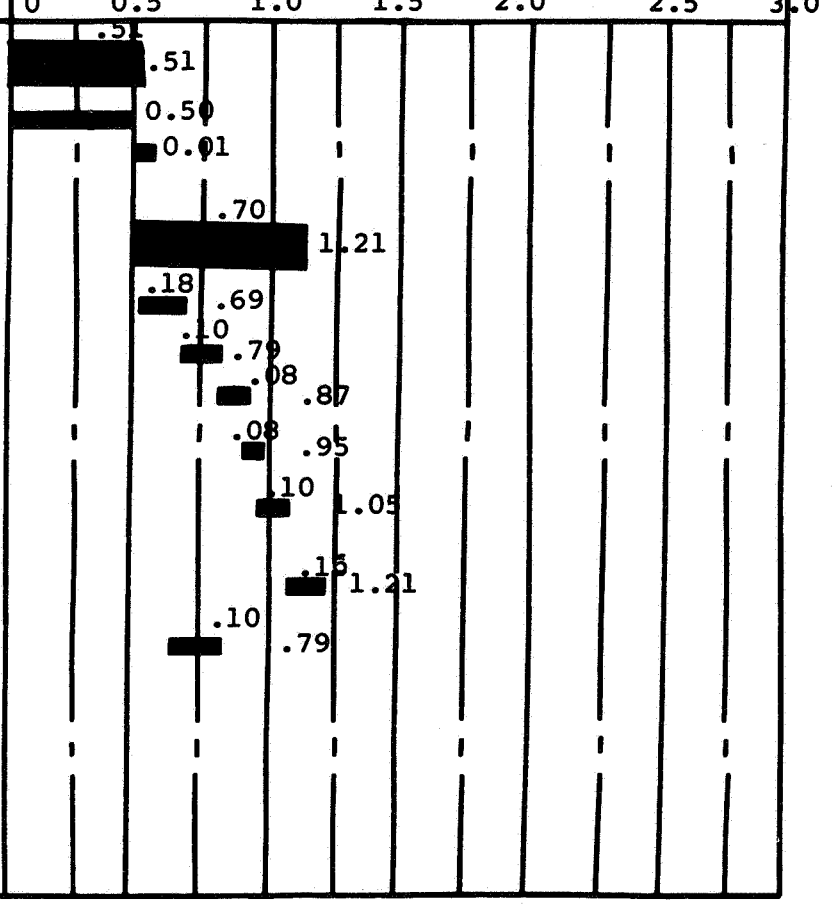


FIGURE 2.5-1; SHEET 2, COMPLETED SAMPLE TIMED FLOW ANALYSIS

~~LOGISTICS BASELINE~~
MAINTENANCE REQUIREMENTS > TIMED FLOW SHEET

PEN/OPS ACTIVITY NO.	TYPE OF MAINTENANCE		PREPARED BY	APPROVED BY
8223. 8227-13	UNSCHEDULED REPAIR			
CROSS REFERENCE	LOCATION	ACTIVITIES/OPERATIONS/TASKS		
Sheet 8 Line 7	D2	ISOLATE		
Sheet 8 Line 8	D2	REPAIR		
Sheet 5 Line 3	D2	VERIFY		

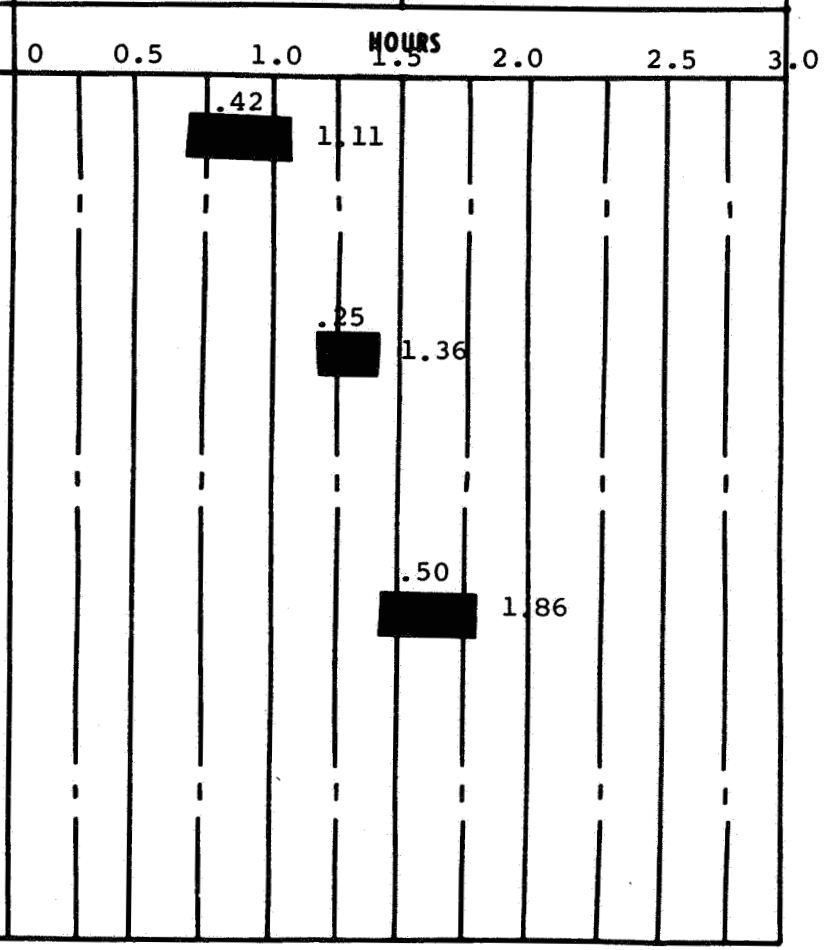


FIGURE 2.5-1; SHEET 3, COMPLETED SAMPLE TIMED FLOW ANALYSIS

~~LOGISTICS BASELINE~~
MAINTENANCE REQUIREMENTS > TIMED FLOW SHEET

PEN/OPS ACTIVITY NO.	TYPE OF MAINTENANCE	PREPARED BY	APPROVED BY
8223. 8227-13	UNSCHEDULED REPAIR		

CROSS REFERENCE	LOCATION	ACTIVITIES/OPERATIONS/TASKS
Sheet 6 Line 4	D2	DISASSEMBLE
Sheet 6 Line 5	D2	REPAIR
Sheet 7 Line 6	D2	REASSEMBLE
Sheet 5 Line 3	D2	VERIFY

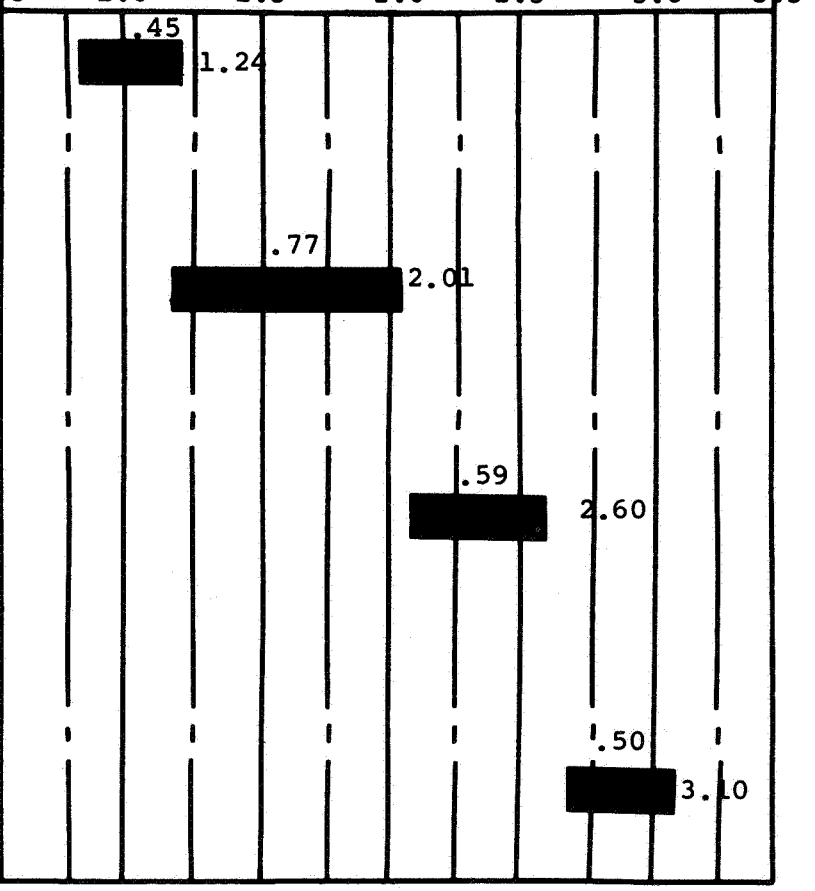


FIGURE 2.5-1: SHEET 4, COMPLETED SAMPLE TIMED FLOW ANALYSIS

~~LOGISTICS BASELINE~~ MAINTENANCE REQUIREMENTS > TIMED FLOW SHEET

PEN/OPS ACTIVITY NO.	TYPE OF MAINTENANCE	PREPARED BY	APPROVED BY
8223. 8227-13	UNSCHEDULED REPAIR		

CROSS REFERENCE	LOCATION	ACTIVITIES/OPERATIONS/TASKS
Sheet 11 Line 14	D2	DISASSEMBLE
Sheet 11 Line 15	D2	REPAIR
Sheet 11 Line 16	D2	REASSEMBLE
Sheet 5 Line 3	D2	VERIFY

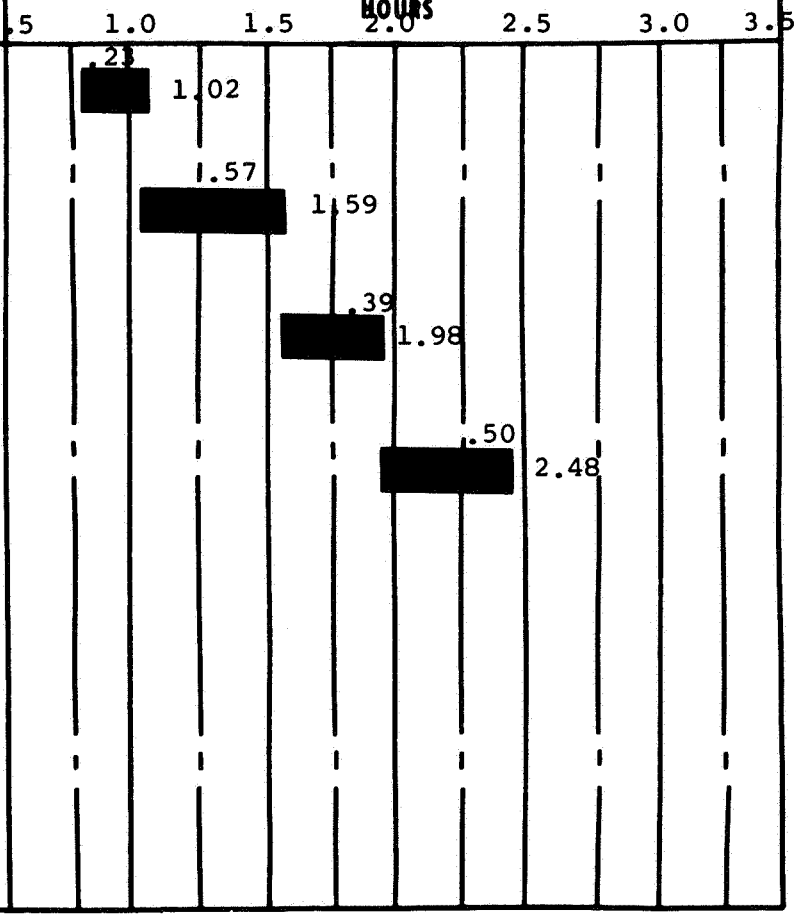


FIGURE 2.5-1; SHEET 5, COMPLETED SAMPLE TIMED FLOW ANALYSIS

~~LOGISTICS BASELINE~~
MAINTENANCE REQUIREMENTS > TIMED FLOW SHEET

PEN/OPS ACTIVITY NO.	TYPE OF MAINTENANCE	PREPARED BY	APPROVED BY
8223. 8227-13	UNSCHEDULED REPAIR		

CROSS REFERENCE	LOCATION	ACTIVITIES/OPERATIONS/TASKS
Sheet 6 Line 4	D2	DISASSEMBLE
Sheet 6 Line 5	D2	REPAIR
Sheet 7 Line 6	D2	REASSEMBLE
Sheet 5 Line 3	D2	VERIFY

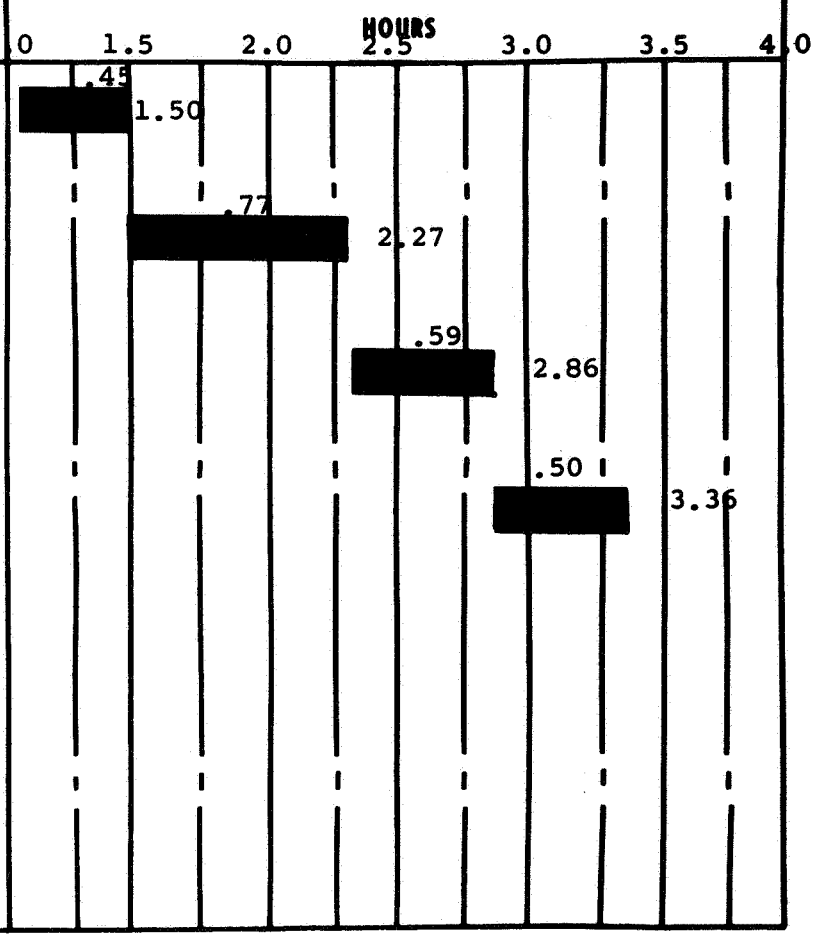


FIGURE 2.5-1; SHEET 6, COMPLETED SAMPLE TIMED FLOW ANALYSIS

~~LOGISTICS BASELINE~~ MAINTENANCE REQUIREMENTS → TIMED FLOW SHEET

PEN/OPS ACTIVITY NO.	TYPE OF MAINTENANCE	PREPARED BY	APPROVED BY
8223. 8227-13	UNSCHEDULED REPAIR		

CROSS REFERENCE	LOCATION	ACTIVITIES/OPERATIONS/TASKS
Sheet 10 Line 12	D2	ISOLATE
Sheet 10 Line 13	D2	REPAIR
Sheet 5 Line 3	D2	VERIFY

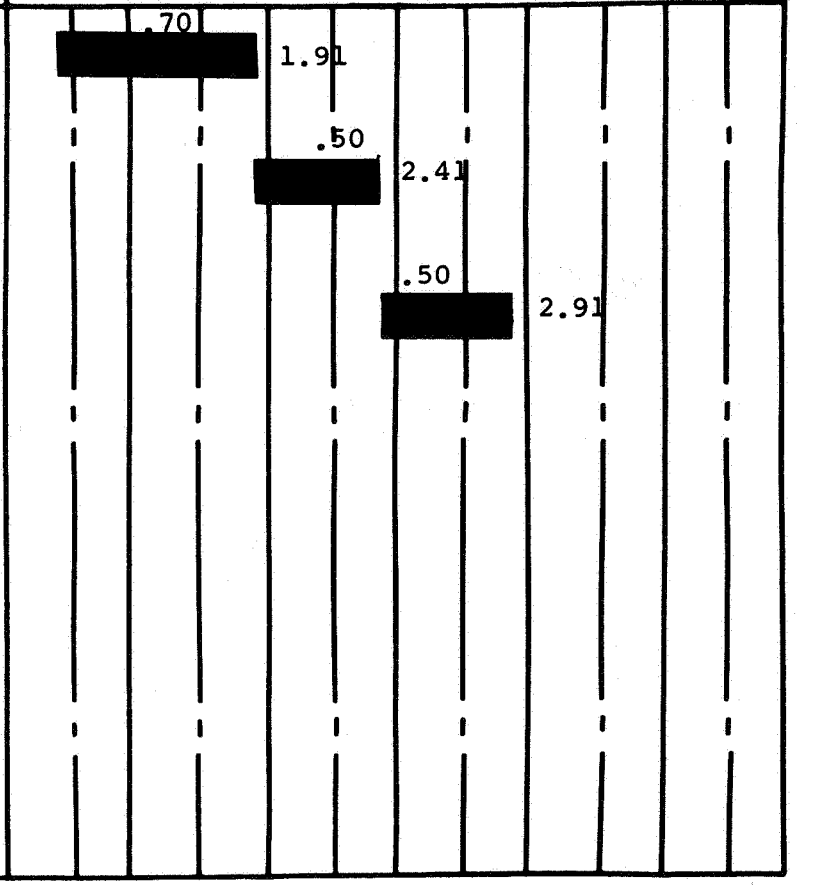


FIGURE 2.5-1; SHEET 7, COMPLETED SAMPLE TIMED FLOW ANALYSIS

~~LOGISTICS BASELINE~~
MAINTENANCE REQUIREMENTS > TIMED FLOW SHEET

PEN/OPS ACTIVITY NO.	TYPE OF MAINTENANCE	PREPARED BY	APPROVED BY
8223. 8227-13	UNSCHEDULED REPAIR		

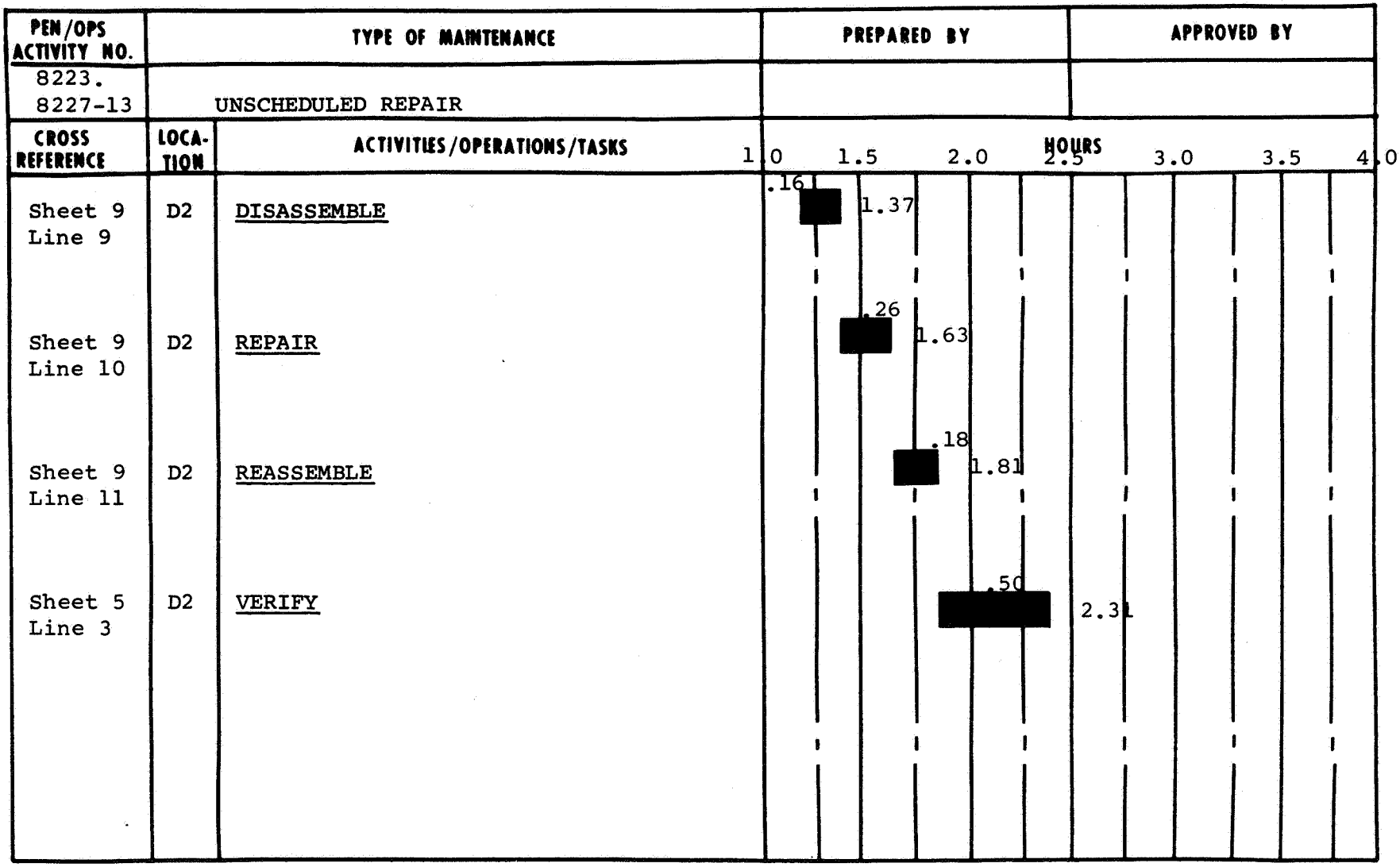


FIGURE 2.5-1; SHEET 8, COMPLETED SAMPLE TIMED FLOW ANALYSIS

3.0 LOGISTICS SUPPORT INTEGRATION

Integrated logistics support information will be prepared based upon requirements identified by the logistics baseline and maintenance requirements analysis. The integrated logistics support information will provide recommendations for site planning, procurement and application of the identified logistics resources. The generation of the information will be divided into separate, but interrelated, areas. During the generation of the information, electronic data processing (EDP) methods will be used. A synopsis of the methods to be used to integrate logistics support data follows:

a. The Site Logistics Requirements Summary will provide quantitative and qualitative data delineating the specific logistics support elements (spares, MGE, personnel, instructions, etc.) required to provide a site's logistics support. As a minimum, a site summary will be provided for each Apollo Program at a site (S-IB, Saturn V, etc.). For sites where multiple programs and/or program vehicle assembly and checkout lines are operating, time phased summary information will be generated to result in joint utilization and downstreaming of Apollo Program assets. The site summary data will be developed by simulation of the AVE operations timed flow into which the scheduled and unscheduled maintenance activities have been inserted on a probability of occurrence basis. The first iteration of the simulation will be accomplished by manual means. Successive iterations will employ computer techniques. The reporting format for the Site Logistics Requirements Summary is described in paragraph 3.1.

b. The Time Flow Simulation will be prepared as a dynamic model using computer simulation to represent the operating system. The model will be based on the Logistic Baseline.

3.0 (Cont.)

The results of this simulation will be used to update the Site Logistics Requirements Summary Report and Logistics Loading. The Time Flow Simulation is discussed further in paragraph 3.1.1.

c. Logistics Loading will identify the qualitative and quantitative personnel skills, equipment, spares, facilities, consumables, and time for those scheduled functions necessary to support the Logistics Baseline activities. It will also identify the contingency maintenance which may occur, the probability of its occurrence, and the logistics support required for unscheduled maintenance. During the loading of logistic resources to support contingency maintenance, consideration will be given to equipment and functional redundancy, reliability, and the point in the sequence at which the contingency occurred to determine whether or not maintenance will be accomplished. Initial Logistics Loading will supply inputs to the Time Flow Simulation and provide operational planning and support data. Logistics Loading will be supported by the logistics baseline, maintenance analysis, time lines and the Time Flow Simulation. Logistics Loading is discussed in detail in paragraph 3.2.

d. Electronic Data Processing will be used as a tool to support the Time Flow Simulation and Logistics Loading. It will also be used for the storage of data for rapid recall purposes during the operational phase. Electronic Data Processing methods will be used for accumulating, storing, and providing data for the preparation and scheduling of both contingency (unscheduled) and scheduled maintenance. Electronic Data Processing is not discussed separately but is considered an integral part of the Logistics Loading Program. A simple flow chart depicting the development of integrated logistics support information and its updating process is shown in figure 3.0-1.

3.1 Site Logistics Requirements Summary

Site Logistics Requirement Summary information will be prepared for each site. A site summary will cover the processing of multiple systems such as two or more Saturn V vehicles simultaneously. The logistics baseline developed under paragraph 1.0, shall be used to provide the basis for site summary information. The site support requirements will be formulated for logistics requirements, quantities of MGE, spares and personnel. A site report will, as a minimum, contain the following:

a. Brief description of the system to be supported.

b. Reference to the Logistics Baseline used in generation of the support requirements.

c. Reference to the Logistics Plan applicable to the site.

d. Listing of the End Item Logistics Summaries applicable to the site.

e. Logistics Loading for the processing of a single system. (Provided as an appendix.)

f. Logistics Loading for the concurrent processing of multiple systems where applicable and time frames are known. (Provided as an appendix.)

g. Information necessary to operate and maintain the supported system(s), spacecraft or end items on a single or concurrent processing basis.

h. System and equipment redundancy will be considered, when applicable, and redundant functional capability analyses will be performed to predetermine the necessity for repairing a malfunction in a redundant system. This will not deter the requirement for a maintenance analysis of that

3.1 (Cont.)

malfunction but will influence the decision to repair only.

Spares and MGE provisioning and supply considerations will include coding of prime and launch or test critical items and, along with the factors considered above, will for all locations, be applied to obtain recommended provisioning activities. The summary will provide for economic utilization of resources with maximum support of the system or site considered. It will cover concurrent flows of separate vehicle systems. These reports will be supported by the Time Flow Simulation (paragraph 3.1.1) and Logistics Loading (paragraph 3.2).

3.1.1 Time Flow Simulation

Simulation of the AVE operations time flow against a real time base will be accomplished to identify and establish the most desirable scheduling of operations flow activities utilizing both equipment operating and personnel task times. The simulation program will introduce required corrective malfunction type maintenance activities on a probability occurrence basis using Monte Carlo or similar random generating techniques. It will provide the integration of the maintenance time based flows into the operations time flow for determining the quantities of logistics support elements required to support the simulated events. The prediction in a given future interval of time will be based upon the operating conditions that will be applicable during the future time interval under consideration. The program will compare the real time remaining with the probable available time to complete the operations flow whenever time is a system constraint. Operability and maintainability trade studies will utilize the time flow simulation program to determine the effect of alternate solutions on time constraints and costs. The simulation program will also be used to verify the

3.1.1 (Cont.)

quantities of logistics support elements which were generated manually by considering malfunctions on a probability of occurrence basis. In other words, elements required to support the randomly simulated failures will be compared with the previously established quantities. The previously established quantities will be revised as necessary to assure effective and economical support. The time flow simulation will be supported by, and in turn support, logistics loading.

3.2 Logistics Loading

Logistics Loading is a part of an over-all process used in the determination of logistics requirements. It requires inputs from maintenance analysis, the logistics baseline, time flow simulation, reliability analysis, spares lists, operations and maintenance instructions and data from live launch cycles (in a later time frame). Logistics Loading in turn provides inputs (on an iterative basis) to some of the same functions and operations. Selective feedback will be employed to continuously refine the data to provide the best support for program operations. Logistics Loading data will be developed to satisfy the following:

a. Determine quantities of facilities, end items, spares, personnel and consumables needed to support a system or a site for single or concurrent tests or launches.

b. Provide planning information for the daily scheduling of the above resources to support the sequence of operations.

c. Provide unscheduled maintenance procedures on a demand basis in the event of malfunction.

d. Provide an operational logistics loading against which live data may be compared. Variations between the planned and actual live usage data will be evaluated to determine and effect warranted logistics loading modifications.

3.2 (Cont.)

e. Provide logistics support data (maintenance time requirements, malfunction resource requirements, locations, availability, etc.) during the conduct of operations in a manner and time frame which will effectively assist Operations to expeditiously decide upon the most desirable course of action to take upon experiencing system malfunctions. Upon the occurrence of malfunctions after certain points in the real time launch sequence, a built-in logistics loading decision may indicate a postponement of the launch. The built-in-decision will be based upon the impact of the time required to correct the malfunction being of such a duration to preclude meeting the scheduled launch window and upon systems reliability and upon mission requirement considerations.

When the end item loading is applied to the integrated flow, similar print-outs will be obtained on a site level.

3.2.1 Coding Instructions for Logistic Loading - Normal Operations and Malfunction Logistic Requirements Summary Sheets (Figure 3.2-1, sheets 1 and 2).

These sheets (Figure 3.2-1) provide an illustrative sample of data extracted from maintenance analyses and related documents of several end items of AGE. The data used for a particular end item is representative of that end item, but does not portray a complete picture of the data pertaining to the end item. All codes used in this program must be approved by the APO 500-3 Inter-Center working group. Additions and changes to codes established will be made by this same group. An explanation of the coding and a list of symbols follows.

3.2.1.1 Day (Column 1)

The Day indicates the particular day related to the AVE Flow sequence. This column will be left blank for loading unscheduled actions and will be a distinguishing indication between scheduled and unscheduled actions.

3.2.1.2 PEN (Column 2)

The program element number of the end item upon which the operations are performed will be entered. This PEN is to be that used in the applicable equipment management system list.

3.2.1.3 Card Number (Column 3)

The card number identifies each of one or more EDP cards bearing the same PEN and the same malfunction symptom and/or same function for the same day. Scheduled and unscheduled loading actions have a separate grouping of cards for each PEN.

3.2.1.4 Symptom (Column 4)

The malfunction symptom is coded by three letters. The symptom will be taken from the LOCALIZE or ISOLATE procedures noted in column D-1 of the maintenance requirements analysis sheet for the particular PEN. The analyst will assign a code on the worksheet for each malfunction symptom listed on the maintenance requirements analysis. A record of the code is made as the analyst assigns each code to unique symptoms, such as "60 CPS 3PH ON Monitor is OFF at SCC." If this is the first symptom coded, it will be assigned code AAA and recorded in the Symptom-Code Worksheet. The second code will be AAB--the third code will be AAC and so on. The Symptom is left blank for scheduled loading actions. The codes will be assigned so that each malfunction throughout the system will have its unique code with no duplication for any particular PEN.

3.2.1.5 Function (Column 5)

The function to be coded is that which has been entered in Column E-10 or E-20 on the Maintenance Activities Analysis Sheet. The functions (also may be referred to as Activities) are assigned codes as follows:

ACTIVITY	CODE
REPAIR:	10
Localize	11
Isolate	12

3.2.1.5 (Cont.)

ACTIVITY	CODE
Disassemble	13
Repair	14
Reassemble	15
Align	16
Verify	17
SERVICING:	20
Prepare	21
Service	22
Reactivate	23
OTHER	AS ASSIGNED (30 through 50)

Definition of the activities is found in paragraph 2.1.1.10.

The resources requirements for several activities can be combined into a single line entry such as Repair or Servicing. This is accomplished by assigning code 10 to include those Repair activities as applicable and by assigning code 20 to include those Servicing Activities as applicable. For example, on Figure 3.2-1, Sheet 1, the second line entry requires 5.0 hours (in column 6) to accomplish the three activities represented by codes 21 (Prepare), 22 (Service), and 23 (Reactivate). If this second line entry were divided into the three functions, three line entries would be needed to list the resource requirements which are now listed in a single line entry using function code 20. When the function to be coded is operational in nature and does not involve maintenance, the assigned code is "51" and on.

3.2.1.6 Time (Column 6)

This will be the time in hours expressed to the nearest one-tenth of an hour required to perform the designated function

3.2.1.6 (Cont.)

or action. In many cases, for unscheduled loading, there will be more than one possible cause for a particular symptom. If the Comparative Maintainability Indices for the various causes are known, use the time required to restore to operating condition corresponding to the highest (least desirable) Comparative Maintainability Index reading. If the indices are unknown, use the longest repair time of the possible causes for that symptom. In either case, list the repair times on subsequent lines, for all malfunctions which give rise to the same symptom.

3.2.1.7 Personnel (Column 7)

There is space for three different skill types of personnel (Columns 7, 8 and 9). On the Live Logistic Requirements Summary Sheet (Figure 3.2-1, sheet 3) there is space for two different skill types (Columns 7 and 8). Coverage of each skill type requires six entry spaces. Refer to Columns 7, 8, and 9 on sheet 1, then observe the following instructions. The first two entry spaces in a personnel column are for the required skill, the third entry space denotes the number of that type skill required and the fourth, fifth and sixth entry spaces indicate the time in hours and tenths that the skill is utilized. (See 3.2.1.11 Remarks for additional space for personnel type.) A skill is represented by two letters as shown below. The three digit skill definition is defined in paragraph 1.2.8.2 and in Appendix C. Coding for skills follows:

AA-101	DA-131	GA-201	JA-321	MA-501	PA-601	SA-801	VA	YA
AB-101	DB-132	GB-202	JB-322	MB-502	PB-602	SB-802	VB	YB
AC-103	DC-133	GC-203	JC-323	MC-503	PC-603	SC-803	VC	YC
BA-111	EA-141	HA-301	KA-331	NA-511	QA-611	TA-901	WA	ZA
BB-112	EB-142	HB-302	KB-332	NB-512	QB-612	TB-902	WB	ZB
BC-113	EC-143	HC-303	KC-333	NC-513	QC-613	TC-903	WC	ZC
CA-121	FA-151	IA-311	LA-401	OA-521	RA-701	UA-911	XA	
CB-122	FB-152	IB-312	LB-402	OB-522	RB-702	UB-912	XB	
CC-123	FC-153	IC-313	LC-403	OC-523	RC-703	UC-913	XC	

3.2.1.8 Maintenance Instructions (Column 10)

This section refers by contractor code and by MSFC Document Number to the applicable maintenance instructions. The two letter contractor code is found in paragraph 3.2.2 a.

3.2.1.9 Equipment Coding (Column 11)

The equipment is composed of Location of equipment used, Type of Equipment used and Time equipment is used.

a. Location (Heading is "L") (where equipment is used)

It is identified by alphabetical code:

A - Launch Control Center (KSC)
B - High Bay in VAB (KSC)
C - Low Bay in VAB (KSC)
D - PAD Area (KSC)
E - LUT (KSC)
F - VAB & PAD (KSC)
G - All MILA
H - All except PAD (KSC)
I - KSC Shops
J - Other KSC Facilities
K - MSFC
L - Contractor Facility

b. Type of Equipment used (Column Heading is "EQ")

Equipment is given by two letter code:

Tester Assembly, Pneumatic C/O No. 1 & No. 2	AA
Tester Assembly, Pneumatic C/O No. 3 & No. 4	AB
Helium Tester S-IC Pneumatic Console RA	AC
Nitrogen Tester, S-IC Flush & Purge	AD
Service Truck, S-IC Flush & Purge	AE
Service Truck, RJ-1/Sodium Nitrite	AF
Special Handling Required - See Remarks	BA

Additional equipment and combinations thereof will be entered as the need becomes known.

c. Time Equipment is used.

The time to the nearest whole hour that the equipment is required will be entered.

3.2.1.10 Replacement Items or Consumables (Column 12)

There are five elements of data in this portion of the chart. They are as follows:

a. The manufacturer by the 5 element DoD numerical code. These are listed in catalogue H-4-1 "Name to Code - Federal Supply Code for Manufacturers" which is published by Defense Logistics Service Center, Defense Supply Agency, Battle Creek, Michigan. For non-listed manufacturers use code 00000 and enter name of manufacturer in Remarks. When a manufacturer has several production facilities, each identified by an H-4-1 code and it is impractical to identify which facility produced the part, use the first code listed for the manufacturer.

b. The Manufacturer's Part Number up to the first 13 characters will be entered.

c. Special spare items will have a 2 character code entered after the part number. Launch and/or test critical spares will be shown by a "C" after the part number entry. Prime spares will be shown by a "P" after the part number entry.

d. The noun of the item is identified by a two letter code. An abbreviated listing is shown below:

Accumulator	AA	Battery	BB	Camera	CE
Door	DF	Ejector	EA	Frequency Meter	FJ
Gear	GD	Hose	HF	Inductor	IB
Jackscrew	JA	Knobb	KA	Lens	LC
Monitor	ME	Motor	MF	Nozzle	NC
Paper	PC	Pump	PQ	Relay	RJ
Starter	SN	Switch	SP	Tape	TB
Union	UN	Valve	VB	Washer	WA

A more complete listing of nouns and their corresponding codes is found in Appendix F.

3.2.1.11 Remarks

The second and subsequent cards for the same P.E.N. and same Symptom or Function contains about 65 character spaces for Remarks. The fact that a 4th Technician of a particular skill is needed is an example of an entry under Remarks, such an entry might read "4th Tech. 113 needed 3.2 hrs." This required 28 character spaces.

3.2.2 Live Logistic Requirements Summary Sheet (Figure 3.2-1, sheet 3)

The format for use with live (i.e., "as run") data will be different from the planned Logistic Requirements Summary Sheet. Columns 9, 10 and 11 are changed. In the format for handling actual data the following changes are appropriate:

3.2.2.1 Contractor (Column 9)

The contractor initiating the unsatisfactory, or other type report will be identified in Column 10. Sample codes follow:

BE	Bendix
BO	Boeing
BR	Brown
DO	Douglas
GE	General Electric
GR	Greer Hydraulics
HA	Hayes
HS	Hamilton Standard
IB	International Business Machines
KS	Kennedy Space Center
MS	Marshall Space Flight Center
NA	North American - Space Information Division
PA	PALL
PE	Perkin Elmer
RC	Radio Corporation of America
RM	MSFC Manufacturing Engineering Laboratory
RO	Rocketdyne
RT	MSFC Test Laboratory
SA	Sanders Associates
SC	Spacecraft, Inc.
SD	Scientific Data Systems Co.
WK	Walter Kidde

3.2.2.2 Report Number (Column 10)

This gives the serial number of the report from which the live data was obtained. The date of the report is recorded in last section of Column 12. This date is shown by the Julian Calendar in 5 digits: For Example, the month is expressed in the first and second digits; the day in the third and fourth digits and the last digit of the year in the fifth digit.

3.2.2.3 Operations Flow Sequence Number (Column 11)

This number specifies the point in time of the operational sequence at which the trouble occurred, or the point in time the data resulting from scheduled live loading occurred.

3.2.2.4 Additional Information for Live Logistic Requirements Summary Sheet

In those cases where live data resulting from scheduled loading activities is to be recorded, Column 10 will be used to record the test conductors' report number or other report number from which the data was obtained. The last two character spaces of this column are reserved for later identification of the type classification of these reports.

3.2.3 Maintenance Instructions Sheet (Figure 3.2-1, sheet 4)

This fourth sheet describes the Maintenance Action to be taken to accomplish a preventative maintenance function, or to correct a malfunction. There are only six columns to the form. The first five columns are identical to those of the previous sheets. The sixth column is Maintenance Action and is a concise summary of the maintenance actions spelled out in the appropriate maintenance instructions.

3.2.4 Reliability Information Summary (Figure 3.2-1, sheet 5)

Reliability data is an input to the Time Flow Simulation and to

3.2.4 (Cont.)

logistic loading. The Reliability Information Summary is similar to the Live Logistic Loading Summary. Personnel requirements and operations flow sequence are omitted and failure rate information is inserted.

3.2.4.1 Additional Coding - Reliability Summary Sheet

This sheet contains data extracted from Reliability Analyses. The reliability entries are presented in failure rate form. The second through the fifth columns are the same as for the preceeding loading forms.

3.2.4.2 Number Operating Cycles (Column 6)

This is the number of operating cycles of the end item in a complete operations flow sequence.

3.2.4.3 Number Start - Stops (Column 7)

This is the number of planned or observed of start-stop sequences performed by the end item in a complete operations flow sequence.

3.2.4.4 Total Operating Time (Column 8)

This is the total operating time of the end item in a complete operations flow sequence to the nearest tenth of an hour.

3.2.4.5 Data Last Failure (Column 9)

The date of the last failure of the PEN is shown in 5 digits; month in two digits; the day in two digits and one digit for the year.

3.2.4.6 Predicted Failure Rate/Time (Column 10)

The failure rate is expressed as a decimal fraction and is calculated for a PEN for a complete launch cycle. A failure rate of 0.3333 would indicate probable failure in 3 launch cycles. A failure rate of 0.1000 would indicate a probable failure in 10 launch cycles. The first listed failure rate applies to the

3.2.4.6 (Cont.)

PEN. The second and subsequent listed rate(s) apply to the particular listed replacement components within the PEN.

3.2.4.7 Experience Failure Rate (Column 11)

The first listed experience failure rate is based upon the cumulative actual failure date for a particular PEN. It is the decimal fraction computed by dividing the number of actual failures by the total time span over which the PEN (or population of PEN's) operated. The second and subsequent listed entries apply to the replacement components listed as subindentures of the PEN.

3.2.4.8 Report Number and Type (Column 12)

The coding is the same as shown in paragraph 3.2.2.1 through 3.2.2.4, except the column number is different.

3.2.4.9 Replacement Components with the PEN (Columns 1 and 13)

The coding is the same as that described in paragraph 3.2.1.10 (a) through (d), except the column number is different. Also, the noun name of the spare component is placed in column 1. In addition the find number of the item is placed in the right section of column 13. The find number is taken from the highest level drawing that identifies the item.

3.2.5 Spares Information Summary (Figure 3.2-1, Sheet 6)

The Spares Information Summary is similar to the Reliability Information Summary. The Spares Information Summary omits several of the Reliability entries and substitutes a provisioning factor and stockage data.

3.2.5.1 Additional Coding - Spares Information Summary Sheet.

3.2.5.2 Card Number (Columns 3 and 4)

The units and tens digits are placed in column 3. In cases where the number of replacement items exceeds 99, the hundreds digit is placed in the first space of column 4.

3.2.5.3 Failure Rate/Time (Column 6)

The failure rate is the same as that defined in paragraph 3.2.4.6.

3.2.5.4 Provisioning Factor

The Provisioning Factor is used to determine the number of spares to stock. It is a multiplying factor used by the spares analyst to quantify the stockage level. Failure rate and criticality of the component are considerations in determining the provisioning factor.

3.2.5.5 Experience Failure Rate (Column 9)

This is described in 3.2.4.7.

3.2.5.6 Stockage (Columns 9 and 10)

Stockage is the number of replacement components (spares) to support a given cumulative number of like installed components contained in the total number of identical P.E.N.'s at a given site. Site location codes are given below:

a. MSF Marshall Space Flight Center
b. KSC Kennedy Space Center
c. MSF Manned Space Center
d. MTO Mississippi Test Facility
e. SAC Sacremento Test Operation

The stockage number if entered in two spaces under "STK" heading and the number of like items being supported is entered in two spaces under "EI" heading.

3.2.5.7 Replacement Components (Column 11)

The coding for Manufacturer, Part Number and Noun Name for type of part is the same described in paragraph 3.2.1.10 (a) through (d). In addition the find number of the component is placed in the right hand section of column 11. The find number is taken from the highest level drawing that identifies the component.

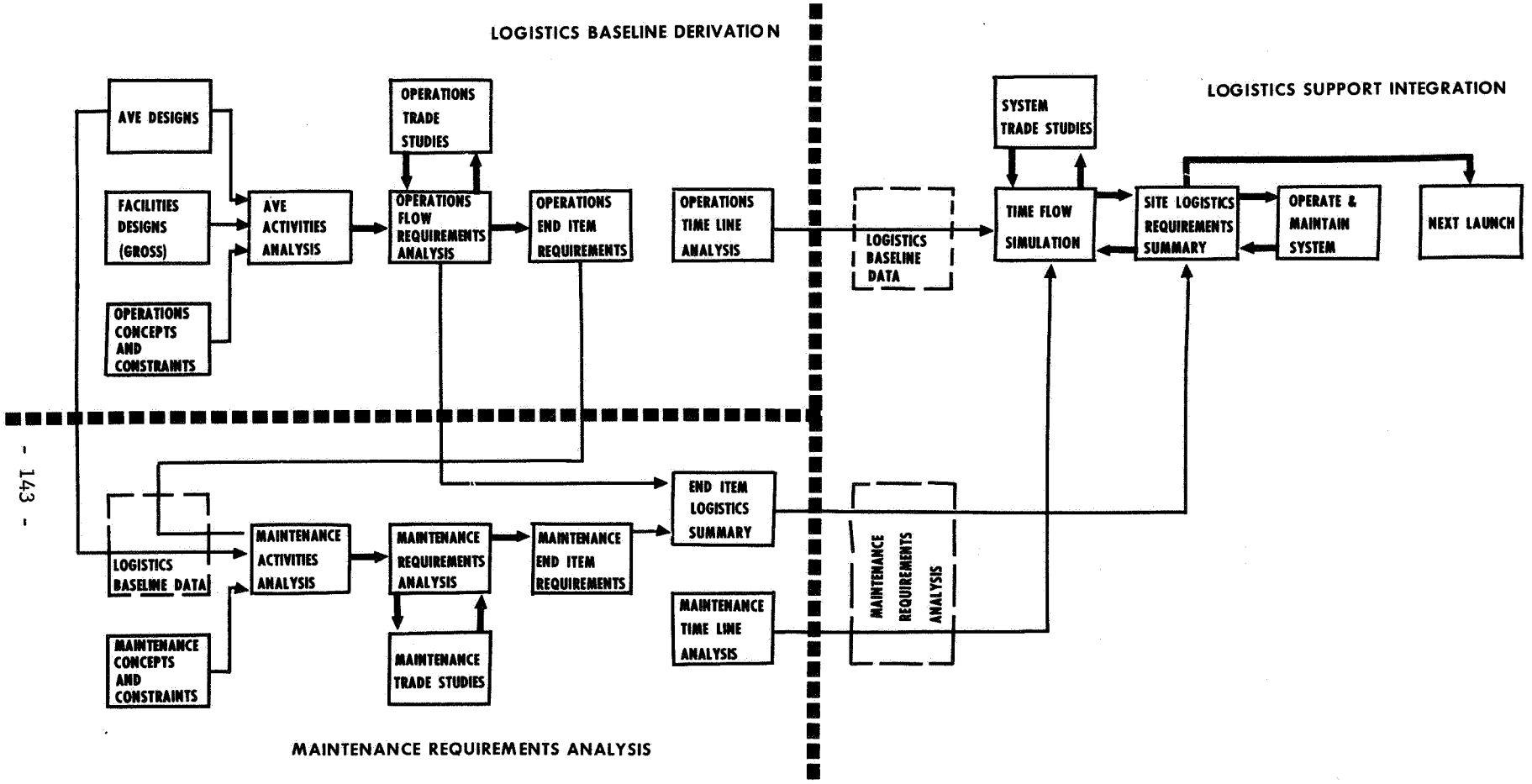


FIGURE 3.0-1; AN OVERVIEW OF THE LOGISTICS SUPPORT INTEGRATION SYSTEM

DAY	P E N	CA RD NR	SYM	FN	TIME	PERSONNEL TYPE SKILL-NR.REQ-TIME 1ST	2ND	3RD	TECH SUP DATA	L	EQUIP EQ HR	MFR	REPLACEMENT ITEMS - CONSUMABLES PART NUMBER	C	TY	MO P	PE	DA Y
1	2	3	4	5	6	7	8	9	10	11			12					
07	2213.02.05	01		11	00.4	BA100.4 GA100.4			GR006	C								
07	2213.02.05	01		20	05.0	BA201.7 GA105.0 GA103.9			GR006	C	AF05	78510	RJ- 1			FJ		05015
		02			A THIRD 111 IS REQUIRED FOR 0.3 HR. 800 GAL RJ-1 REQ													
07	2213.02.05	01		17	01.6	BA100.9 GA100.7			GR006	C	AF05							05015
07	2213.02.05.04	01		11	01.0	EA101.0 EB101.0			B0003	E								08015
08	2213.02.05.	01		15	01.4	GB101.4			GR006	E								05015
08	2213.02.05.	01		16	08.4	BC107.3 GB208.4			GR006	E								05015
08	2251.33.01.01	01		16	00.4	EA100.2 EB100.3			B0002	F								07015
08	2254.04.02.	01		11	00.2	KA100.2			B0005	B								08015
08	2254.04.01.	01		12	00.1	GA100.1			B0002	C								07015
09	2213.02.05.04	01		20	00.6	AA100.6 BA100.2			B0003	E		96795	RECORDING 4H5			IH		08015
		02			CHART PAPER 2 CHANNEL RA2922-22 REQ.													
09	2213.02.03	01		11	00.5	FC100.5			WK007	E								04155
09	2213.02.03	01		20	05.3	FC104.3 KA100.7 BC101.2			WK007	E	AF	83339	NANO2					04155
		02			A 332 SKILL NEEDED FOR 1.2HR.807 GAL MIN REQ NANO2													
09	2251.33.01	01		16	02.9	GA102.4 GB101.1 GC100.8			B0002	F								07015
		02			A 112 SKILL NEEDED FOR 0.3HR.													

FIGURE 3.2-1; SHEET 1, SAMPLE SCHEDULED ACTIVITIES LOGISTICS LOADING

DAY	P F N	CA RQ NR	SYM	FN	TIME	PERSONNEL TYPE SKILL-NR.REQ-TIME 1ST	2ND	3RD	TECH SUP DATA	L	EQUIP EQ HR	REPLACEMENT ITEMS - CONSUMABLES MFR	PART NUMBER	TY MO H	PE	DA Y
1	2	3	4	5	6	7	8	9	10		11		12			
	2213.02.05	01	AAA	10	00.5	BA100.5			GR006	E		55354	101-N-0		ME	05015
	2213.02.05	01	AAB	10	00.5	BA100.5			GR006	E		55354	101-N-0		ME	05015
		02			00.2	BA100.2						24446	RACPL PGA		RJ	05015
	2213.02.05	01	AAD	10	01.0	BA201.0			GR006	E		24446	CR120029135AA		RJ	05015
		02			00.9	BA200.9						24446	CR120029135AA		RJ	05015
		03			01.0	BA201.0						24446	CR120A02002AA		RJ	05015
		04			01.0	BA201.0						24446	IC2820A200A-B		RJ	05015
		05			01.0	BA201.0						24446	CR120029135AA		RJ	05015
	2213.02.05	01	AAK	10	00.5	BB100.5			GR006	E		55354	101-N-0		ME	05015
		02			00.4	BB100.4						91510	LM831610		VB	05015
	2213.02.05	01	AAM	10	27.5	BA127.5 GA326.3 BB101.0			GR006	E	BA26	93232	P/IV-2-1/2DNE-82		PQ	05015
		02			00.5	BA100.5						55354	101-N-0		ME	05015
		03			00.8	BA100.8						24446	169X86461		SN	05015
		04			01.0	BA101.0						24446	IC2820A200A-B		RJ	05015
		05			01.0	BA101.0						24446	BUL10182H3		RJ	05015
		06			00.7	BA100.7						24446	3AIS12-3		SP	05015
		07			SEE PAGE 88 MRA FOR HANDLING REQ.											
	2213.02.05	01	AAU	10	09.6	BA109.6 GA209.4			GR006	E	BA10	24446	5K4256X8ZXT9	C	MF	05015
		02			00.5	BA100.5						55354	101-N-0		ME	05015
		03			00.9	BA100.9						24446	IC2820A200A-B		RJ	05015
		04			00.9	BA100.9						24446	MV2C600P-33		RJ	05015
		05			08.7	BA108.7 GA208.7					BA09	16956	PV-05T-006-31R-P		PQ	05015
		06			SEE PAGE 88 MRA FOR HANDLING REQ.											
	2213.02.05	01	AAT	10	64.5	GA164.5 GB164.5 GA140.0			GR006	E	BA65	24446	5K814321X	P	MF	05015
		02			00.5	BA100.5						55354	101-N-0		ME	05015
		03			44.5	GA144.5 GB144.5 GA138.0					BA45	16956	PXX-122-3-609-LH		PQ	05015
		04			00.8	BA100.8						24446	105E002 SIZE 3		JK	05015
		05			00.8	BA100.8						24446	CR120A02002AA		RJ	05015
		06			SEE PAGE 69 MRA FOR HANDLING REQ.											

FIGURE 3.2-1; SHEET 2, SAMPLE UNSCHEDULED ACTIVITIES LOGISTICS LOADING

DAY	P/N	CA	SYM	FN	TIME	PERSONNEL TYPE	REPORT	OPERAT.	REPLACEMENT ITEMS - CONSUMABLES
		RD				SKILL-NR-TIME	NUMBER	SEQ	MFR PART NUMBER TY MO
		NR				1ST 2ND	CO AND TYPE	NUMBER	H PE DA
1	2	3	4	5	6	7 8	9	10	11 Y
07	2213.02.05	01		20	05.4 BA201.9 GA105.1 BD T21759 TC 8261-14 78510 RP-1				FJ 05015
		02			THIRD 201 NOT REQ. HIAC AUTOMATIC PARTICLE COUNTER				
		03			MODEL PC203 IS NOT ADEQUATE - MODEL PC209 WOULD BE				
		04			ADEQUATE (SAMPLE ENTRY)				
09	2213.02.03	01		20	05.0 FC104.3 KA100.7 WK R27342 TC				04155
		02			SKILL 113 NEEDED 1.0HR. MINIMUM OF 3 PORTABLE WORK				
		03			LIGHTS REQ. (SAMPLE ENTRY)				
09	2251.33.01	01		16	03.2 GA102.8 GB101.1 BD T31770 TC 8367-07				07015
		02			SKILL 111 ALSO NEEDED 1.0HR. THIRD STEP MAINT ACTION				
		03			ON LINE 6 NEEDS CLARIFICATION.				
	2213.02.05	01	AAB	10	00.4 BA100.4	GR PR7815	8124-16	55354 101-N-0	ME 05015
	2213.02.05	01	AAM	10	26.4 BA126.4 GA326.0	GR PR7861	8221-07	93232 P/IV-2-1/2DNE-82	PQ 05015
		02			HOISTING CAPACITY CALLED OUT BY HANDLING REQ SHOULD				
		03			BE INCREASED BY 20 PER CENT				
	2213.02.05	01	AAU	10	08.9 BA108.9 GA208.9	GR PR7912	8176-03	16956 PV-05T-006-31R P	PQ 05015
		02			INSTRUCTIONS FOR REMOVAL OF PUMP NEED REVISION. MINIMUM				
		03			OF THREE ADDITIONAL STEPS REQ ON MAINT ACTION LINES 9				
		04			THRU 12 .A 17/32 ALLEN HEAD WRENCH REQ FOR REMOVING				
		05			INTERNAL WRENCHING SET SCREW (SAMPLE ENTRY)				

FIGURE 3.2-1; SHEET 3, SAMPLE LIVE LOGISTICS LOADING

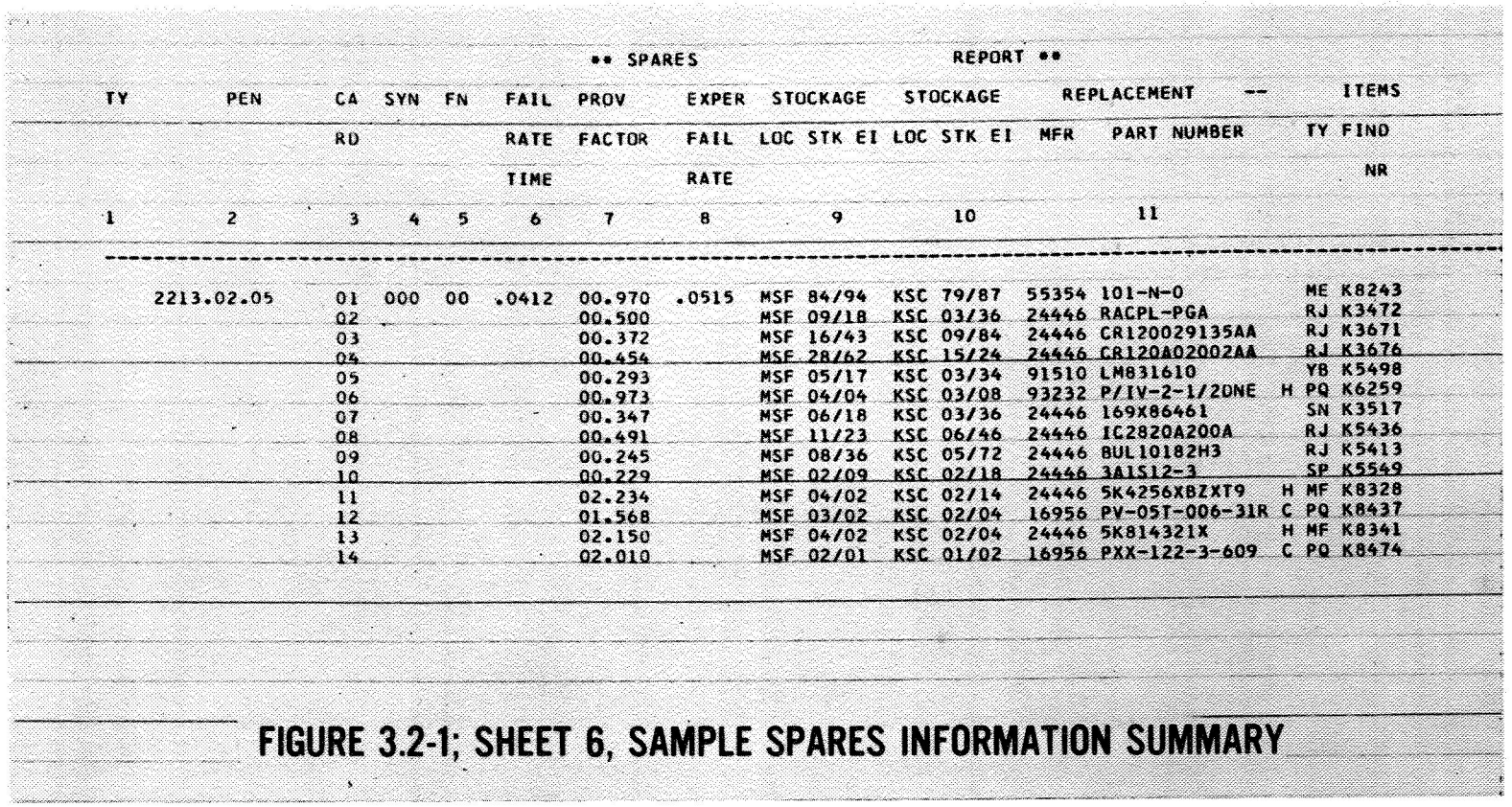
DAY	PEN	CA RD / NR	SYM	EN	MAINTENANCE ACTION
1	2	3	4	5	6
09	2213.02.03	01 02 03 04		11	' GAIN ACCESS TO THE INERT PREFILL UNIT LOCATION. PLUG IN WORK LIGHT TO PERMIT ILLUMINATION OF ALL AREAS OF THE INERT PREFIL UNIT. PERFORM A VISUAL CHECK OF ALL COMPONENTS OF THE UNIT FOR LEAKS OR DAMAGES. '
	2213.02.05	01 02 03 04 05 06 07 08 09 10	AAM		' SUPER CHARGE PUMP ON ' MONITOR (DS4) IS OFF AT SCC. OBSERVE ''SCHG PRESS OK'' MONITOR (DS35) IF ''ON'', MONITOR DS4 IS AT FAULT. CHECK FOR 440 VAC AT TB63-1,TB63-2,TB63-3 AT MJB. IF VOLTAGE IS PRESENT, MOTOR PUMP A8120/B1 IS AT FAULT. PUSH OL1 -1,OL1-2,OL1-3 RESET. CHECK FOR 110 VAC AT MCCTB51-10. IF VOLTAGE IS PRESENT, MOTOR STARTER MS1 IS AT FAULT. CHECK FOR 28VDC AT MCCTB51-7. IF VOLTAGE IS PRESENT, RELAY K10 IS AT FAULT. CHECK FOR 28VDC AT MCCTB18-51. IF VOLTAGE IS PRESENT, CHECK FOR SAME VOLTAGE AT MCCTB18-27. IF VOLTAGE IS PRESENT, RELAY K16 IS AT FAULT.

FIGURE 3.2-1; SHEET 4, SAMPLE MAINTENANCE INSTRUCTIONS SHEET

** RELIABILITY FORMAT **

TY	PEN	CA RD	SYM	FN	NR OP CY	NR S-S	TOTAL OPER TIME	DATE LAST FAIL	FAIL RATE/ TIME	EXPER FAIL RATE	REPORT NUMBER CO AND TYPE	REPLACEMENT -- MFR PART NUMBER	ITEMS FIND NR
1	2	3	4	5	6	7	8	9	10	11	12	13	
	2211.08.19.05	01			019	019	0034.1	10104	.0167	.0183	BO T172412		
	2213.02.03	01			008	010	0124.6	02045	.0337	.0245	WK R27342		
	2213.02.05	01			021	021	0305.2	05075	.0412	.0515	GR PR815		
	2233.01.08	01			043	043	0096.2	08015	.0351	.0374	HA 41891		
	2243.01.01	01			014	014	0081.6	06115	.0198	.0103	PA 241798		
	2244.01.03	01			027	027	0158.3	08154	.0289	.0296	BR 6379		
	2251.04.01	01			131	131	1384.9	02245	.0176	.0215	RC 164293		
	2251.16.02	01			093	095	0045.9	08135	.0019	.0090	BE 7694		
	2251.33.01	01			004	004	0029.7	06095	.0513	.0127	TC 8367-07		
	2254.04.02	01			007	008	0068.4	03175	.0283	.0332	BO T1694731		

FIGURE 3.2-1; SHEET 5, SAMPLE RELIABILITY INFORMATION SUMMARY



** SPARES REPORT **

TY	PEN	CA RD	SYN	FN	FAIL RATE TIME	PROV FACTOR	EXPER FAIL RATE	STOCKAGE LOC STK EI	STOCKAGE LOC STK EI	REPLACEMENT -- MFR	PART NUMBER	ITEMS TY	FIND NR
1	2	3	4	5	6	7	8	9	10	11			
	2213.02.05	01	000	00	.0412	00.970	.0515	MSF 84/94	KSC 79/87	55354	101-N-0	ME	K8243
		02				00.500		MSF 09/18	KSC 03/36	24446	RACPL-PGA	RJ	K3472
		03				00.372		MSF 16/43	KSC 09/84	24446	CR120029135AA	RJ	K3671
		04				00.454		MSF 28/62	KSC 15/24	24446	CR120A02002AA	RJ	K3676
		05				00.293		MSF 05/17	KSC 03/34	91510	LM831610	YB	K5498
		06				00.973		MSF 04/04	KSC 03/08	93232	P/IV-2-1/2DNE	H PQ	K6259
		07				00.347		MSF 06/18	KSC 03/36	24446	169X86461	SN	K3517
		08				00.491		MSF 11/23	KSC 06/46	24446	IC2820A200A	RJ	K5436
		09				00.245		MSF 08/36	KSC 05/72	24446	BUL10182H3	RJ	K5413
		10				00.229		MSF 02/09	KSC 02/18	24446	3A1S12-3	SP	K5549
		11				02.234		MSF 04/02	KSC 02/14	24446	5K4256XBZXT9	H MF	K8328
		12				01.568		MSF 03/02	KSC 02/04	16956	PV-05T-006-31R	C PQ	K8437
		13				02.150		MSF 04/02	KSC 02/04	24446	5K814321X	H MF	K8341
		14				02.010		MSF 02/01	KSC 01/02	16956	PXX-122-3-609	C PQ	K8474

FIGURE 3.2-1; SHEET 6, SAMPLE SPARES INFORMATION SUMMARY

4.0 APOLLO PROGRAM SPARES PROVISIONING

A comprehensive and integrated Apollo Program spares provisioning management system is to be developed and established and made an integral part of the logistics program at each NASA Center requiring program spares to discharge its assigned Apollo Program responsibilities. These systems are to provide documented methods and procedures providing effective management and control over the methods and time phasing used by program participants to select, quantify, allocate, release, procure, price, preserve, pack, mark, inspect, accept, deliver, replenish, configuration control, and to measure, control and report spares provisioning requirements and status. These spares provisioning management systems are to be postured and applied in a manner which provides positive assurance that its sponsoring Center's program spares requirements will be satisfied in the most timely and economical manner consistent with program schedule requirements. The subsequent portions of Section 4.0 describe requirements which are to be made an integral part of the Apollo Program spares provisioning management systems.

4.1 Inter-Center Spares Provisioning Integration

Each NASA Center's Apollo Program logistics function will develop, establish and utilize effective and efficient methods for accomplishing inter-Center liaison and coordination which assures that the spares provisioning practices of the Centers' in-house and contractor organizations are integrated and program compatible.

4.2 Spares Provisioning Plans

NASA Centers' Apollo Program logistics functions will require that comprehensive provisioning plans be established covering

4.2 (Continued)

all their equipments spares provisioning requirements. These plans are to encompass all of the provisioning actions required (spare selection, quantification, distribution, etc.) to deliver required spares and repair parts to their using locations supply facility in consonance with program schedule spares support need dates. These actions will be prepared in schedule format portraying projected action milestone dates and their associated time spans. These schedules are to be used to display the status of provisioning action completion and as a control to assure that required provisioning actions are completed in consonance with program schedule requirements.

4.3 Spares Selection

Apollo Program spares provisioning personnel are to collaborate with their associated organization's maintenance requirements analysis personnel and jointly select program spares for which provisioning actions are to be consummated. Selected spares will be recorded in accordance with the maintenance requirements analysis provisions in Section 2.0 of this Plan, Part II. Bulk and standard repair parts will also be selected for the scheduled and/or unscheduled maintenance activity and listed for bulk and standard item provisioning. Selection of the spare to be used in consummating maintenance actions for all maintenance levels and locations for AVE, OGE, MGE and reparable spares will be based upon comprehensive joint maintenance analysis and spares provisioning trade studies which are to determine, compare, and document the relative program advantages of alternative approaches for the maintenance and provisioning of assemblies, subassemblies, or components. As a minimum, the factors which will be considered in selecting the logical spare are as follows:

4.3. (Continued)

a. Physical restraints limiting removal and replacement of the alternative spares which can be used to correct malfunctions.

b. Allowable time to complete the required maintenance actions compared to the cycle times required using alternative spares. These comparisons will consider all required maintenance activities (e.g., fault isolation to the alternate spare's locations within the equipment or system, personnel response time, emplace work platforms, system safing, remove and replace, checkout, etc.).

c. The most satisfactory balance between the maintenance action rate and the comparative program costs which will be incurred using alternative spares level selections to effect the required maintenance action.

d. The removal actions required for selected spares will not jeopardize the equipment or personnel.

e. Relative program costs of providing system OGE capability to fault isolate to the alternative spares levels versus providing MGE to accomplish this fault isolation to the spares level being considered.

The maintenance time factor, item (b) above, evaluated against the AVE operations flow time remaining to launch or to complete test will be the basis for establishing mission spare criticality which will be denoted by coding in the spares provisioning documentation and drawings for use in the determination of quantity by location, ordering actions and supply locations. These "launch and/or test critical" coded spares will be procured and pre-positioned at the exact use location exclusively for the particular maintenance contingency.

4.3 (Continued)

In addition to the "launch and/or test critical" spares, special treatment will be given first level maintenance spares whose complexity of design and high failure frequency dictate a supply of these items at the site location. These items will be referred to as "prime" spares and appropriately coded to denote same on the drawings and provisioning documentation.

4.4 Reparable Spares

Reparable spares are those spares which, through trade studies by the maintenance requirements and spares provisioning analysts, have been determined technically capable of and economically advantageous to repair when they have failed. Technical feasibility will include such factors as item complexity with regard to replacement of internal components, special tooling requirements and personnel skills which have to be maintained to accomplish the repair, risk of degrading spare reliability by repair actions, etc. Economic feasibility will include volume of each reparable spare being processed to any one location, intra-site handling and repair cycle time, unit cost of spare, cost of special tooling or repair equipment and/or facilities, low inventory stockage due to infrequent use, etc.

The selected location for the repair of these reparable spares will be evaluated and coded for prime or vendor repair in appropriate spares provisioning documentation. Consideration will be given to prime contractor versus vendor and whether the repair will be accomplished at the prime contractor facility, site facility, or vendor facility. Factors which will be considered in location selection are warranty provisions, proprietary rights, frequency of repair, special vendor test equipment which must be added, environmental constraints, repair cycle time schedule compatibility

4.4 (Continued)

and comparative resultant costs. When the assessment conclusions so indicate, the reparable spares will be processed to the vendor for repair. Repair parts for the repair of vendor reparable spares will, with the exception of certain insurance-type items which must be stocked at the vendor facility, be procured through the prime contractor.

4.5 Spares Quantification

The actions called for in Section 3.0 of this Plan, Part II (Logistics Requirements Summary Information) will provide summary spares requirements information delineating the total quantity of each selected line item spare which must be available in a serviceable condition at each maintenance level and location to assure adequate spares support for the maintenance activity requirements at these levels and locations. The determination of the correct quantity of selected spares to be provisioned to assure the availability of the required serviceable spares quantities at each maintenance level and location will require systematically performed adjustments of the logistics requirements spares summary information to judiciously take into consideration each selected spares' associated design stability, pipeline quantities, intra-site handling and repair cycle time requirements, replenishment cycle, unit cost, and the degree of managerial spares status monitoring action planned for the spare in question. The NASA Center Apollo Program logistics functions are responsible for assuring that their parent Center's in-house and contractor organization's spares provisioning methods for performing these adjustments are documented, compatible, and structured in a manner which will correctly determine the minimum quantity of spares and repair parts which must be provisioned to provide proper confidence levels that these products will be available at their needed locations in quantities which

4.5 (Continued)

preclude program schedule slippages and/or extra costs due to their inadequate supply. In addition, they are responsible for performing comprehensive periodic reviews of these organizations' provisioning actions to assure their consonance with program spares needs and to assure that proper follow-through spares ordering and supply actions are consummated in support of these provisioning actions.

4.6 Specialized Spares Provisioning Methods

Each NASA Center's Apollo Program logistics function is to develop, document, and establish specialized program spares provisioning procedures providing the logistics function with stringent managerial control over the provisioning of spares which:

a. Have high unit cost or which are required in quantities representing a large program investment.

b. Have limited potential program effectivity due to programmed changes in end item configuration.

c. Have a high probability of design change obsolescence.

d. Are mission critical and which cannot be procured in the desired total quantity due to limited production capability.

e. Due to their low probable need and high unit cost, will not be acquired as program spares but which must be covered by emergency contractor plant supply capabilities.

These documented procedures are to encompass the techniques to be used by program participants to identify and code the above described types of spares and the means to be used for their status control and reporting. In addition, these procedures are to be postured to assure that any procurement of

4.6 (Continued)

these spares is on a closely controlled and time phased basis to maintain their inventory levels at the lowest level consistent with their probable demand frequency so as to assure minimum spares inventory cost risks.

4.7 Interim Spares Order Release Systems

Each NASA Center's Apollo Program logistics function is to develop, document and establish interim spares order release systems to permit selected program contractors to initiate production and/or acquisition of their associated mission critical spares or spares' material requirements in advance of completing these spares' normal provisioning process when and if such interim order releasing is essential to satisfy established program spares' support requirements. Program contractors who are allowed to exercise interim release procedures are to be required to cover each interim release action with a documented analysis which conclusively justifies the interim release action. These contractors are to be required to make these analysis documents available for NASA review within 15 working days after the interim release action. NASA Apollo Program organizations are required to perform systematic critical reviews of all their associated contractor's interim release activities on a periodic basis which is not to exceed 60 calendar days.

4.8 Bulk and Standard Item Provisioning

Apollo Program contractors are to be required to submit their bulk and standard item requirements generated by their provisioning actions to their cognizant NASA Apollo Program Center logistics organization. NASA Apollo Program organizations are to compile these and any other requirements for such commodities and establish centralized supply sources for same at the program test sites

4.8 (Continued)

and KSC to supply the site contractors' requirements for bulk and standard items. The NASA organization responsible for the management of a centralized site supply source shall assure the establishment of supply system procedures which result in the capability to respond to the site contractor requirements for the centrally controlled items within time frames precluding program schedule delays or extra program costs.

4.9 Contractor Rapid Resupply

Each NASA Center's Apollo Program logistics function will assure that contractor production line support is available for rapid response to those prime hi-value and mission critical spares which, due to design complexity, high cost, long lead procurement or high frequency use, require special procurement action to maintain low level inventory without degrading spares availability at the use location. This support will commence with initial equipment installation and be sustained through the test and operational phases. The Center logistics function will assure that contractors respond to this rapid resupply capability in an organized cost effective manner by requiring Center approval of a rapid resupply plan and subsequent quarterly reviews of the contractors' resupply program.

4.10 Spares Replenishment

NASA Centers' Apollo Program logistics functions are to develop and effect spares replenishment program controls which assure that spares replenishment quantity and order release timing are determined by and in consonance with the most current applicable logistics requirements summary information and the spare's current posture with respect to design stability, unit cost, replenishment time requirements, intra-site handling and repair cycle requirements, pipeline requirements and impending changes in end item configuration and/or program schedules.

4.11 Spares Procurement

4.11.1 Each NASA Center will require incremental submittal of a priced spares list from his respective contractors starting 90 days after contract negotiations have been consummated. Revisions to these priced spares lists will be made at not more than 60-day intervals thereafter and continue until such time as the list has been established as a spares exhibit by contract amendment.

4.11.2 Spares delivery schedules for operations phase-procured items will be designated so that the full range of spares support is available for use at the site 15 to 30 days prior to the site activation hardware use date. When this is impractical, because of spares leadtime, those spares will be scheduled for delivery concurrently with the operations phase end item use date. For example, spares for the first item of AGE to be installed during MILA Complex activation will be schedule to the site supply prior to activation checkout of that item. The same time span will be allowed for the last item of AGE to be installed. This approach will assure that initial spares cover both equipment activation and subsequent operations.

4.11.3 The Apollo Program Centers' logistics function will require spares quantity and delivery requirements to be submitted by the contractors for their Government-Furnished Property (GFP) which is to be incorporated into their production end items. These spares requirements are to be derived by the methods used in 4.3 and 4.5 and delivery dates specified for GFP incorporation into the end item and spares support to the activation, test and operations program. GFAE (Associate Contractor items) spares requirements will be provided in the same manner and coordination of these items with the Associate Contractor will be the responsibility of the prime AVE contractor. The spares provisioning lists for GFP and GFAE will contain:

4.11.3 (Continued)

a. Item Number

b. Federal Stock Number (if available)

c. Part Number

d. Nomenclature

e. Reference Drawing Number

f. Units Required (quantity by location and date required)

4.11.4 Spares will be delivered and documented by a DD-250 form and will be in consonance with the provisions of NPC 500-1. Although spares will be delivered to each NASA Center, provisions will be made for the contractors to retain custody and control of these spares at the factory, test sites and KSC for his contractual accomplishments. Authority will be given the contractor to repair and modify these parts to the approved CCB configuration to meet his contractual AVE and AGE support requirements. Modifications to delivered spares will be made in accordance with furnished modification kits and instructions approved by the appropriate Center Configuration Control Boards. Spares records will be posted to reflect modifications requirements and completions and the spare nameplate stamped to indicate incorporation of the modification.

4.11.5 Spares Ordering and Identification

Each NASA Center's logistic function will establish methods for ordering and identifying spares. Where possible, spares will be ordered by their true manufacturer's or standard's part numbers to prevent the separate ordering and stocking of two identical items under different suppliers' part numbers. Spares requiring special specifications will be ordered by the specifications control drawing part number. For purposes of

4.11.5 (Continued)

accountability, tracking of reparable spares and logistics requirements summary information for second and third level maintenance, a means of identification such as the program element numbering (P.E.N.) system will be provided.

4.11.6 Spares Inspection and Acceptance

Procured, repaired, modified or reconditioned spares will be inspected and accepted to current Apollo Program quality control standards where no special specifications apply.

4.11.7 Preservation, Packaging and Marking

Spares will be cleaned, preserved, packaged and marked, in accordance with NPC 500-1. Preservation and packaging will be the minimum required for adequate protection of the item commensurate with the destination of the shipment, mode of transportation and anticipated storage environment. Exterior packaging will be marked for ease of identification. Means will be provided for required periodic visual inspection of the packaged item. Permanent reusable shipping containers for spares subject to repair, calibration, etc., will be utilized to attain economy in packing, handling, shipment and storage during the programed life of the spare.

4.12 Spares Summary Information

The spares provisioning summary information will be an integral part of the logistics requirements summary information as described in Section 3.0 of this Plan, Part II. Each NASA Center's Apollo Program logistics function is to provide in the spares portion of each site's logistics summary, a listing of all reparable spare items including their repair facility location, parts and materials for their repair. Also included will be procedures for controlling and recording maintenance level 1, 2

4.12 (Continued)

and 3 reparable spares that will include location, destination, promised and actual availability dates and required urgency for repair of each failed item. The procedures will be coordinated with all contractors and vendors and approved as standard operating procedures.

4.13 Spares Provisioning Management System Controls

4.13.1 Apollo Program spares management controls will be established by each NASA Center's logistic function to maintain their program visibility on all spares provisioning actions and status. Spares provisioning schedules, compatible with the Apollo Program's master schedules, are to be established and will depict the time phased relationship of all spares provisioning support elements and the projected milestones necessary to assure satisfaction of the Apollo Program's spares need dates. These spares provisioning schedules will portray interrelationships of spares activities and other program milestones to establish a complete program interface.

Program spares status visibility relative to these schedules will be maintained by requiring program contractors to prepare and submit monthly spares exception reports covering their assigned spares responsibilities. These spares exception reports will be prepared based upon the contractors' spares shipping and site receival program schedule requirements and are to identify all actual and forecast spares delinquencies which could adversely affect Apollo Program schedules. As a minimum the report shall set forth the following information in alpha-numerical delinquent part number order:

(a) Part number.

(b) Nomenclature.

(c) Spares category.

(d) Manufacturer's code.

4.13.1 (Continued)

(e) Reason(s) for delinquency.

(f) Remedial actions being taken by the contractor.

(g) Contractor's predicted delinquency recovery date.

(h) Recommended NASA action, as applicable, for alleviating the delinquency.

NASA Apollo Program organizations receiving these reports shall take appropriate corrective action to resolve unsatisfactory conditions and will use the reports as one means of measuring contractor spares performance.

4.13.2 Administratively reserved funds will be allocated to the program contractors for incremental procurement of spares. Methods will be developed for the allocation and control of these funds throughout the life of the Apollo Programs. NASA Centers will require immediate notification by the contractor whenever the contractor's spares release actions will exceed the reserved funding for the funding time period.

4.13.3 Records will be required by all NASA Centers of their respective program contractors covering estimated future spares release requirements and actual procurement by line item and cost. NASA Centers will require reports on contractor schedules and status, funding status and six-month spares release forecast at not less than 30-day intervals. Each NASA Center's logistics function will be prepared to report spares schedule and funding status to the Apollo Program office quarterly.

5.0 APOLLO PROGRAM SUPPLY SUPPORT

An Apollo Program supply management system is to be developed, established and made an integral part of the logistics program at each NASA Center assigned program logistics responsibilities. These systems are to include the documented methods and procedures to be used for providing effective and efficient management of the supply system employed by program participants for fulfilling their assigned program supply system obligations.

Once Apollo Program equipments and spare parts have been selected, quantified, procured and scheduled to their geographical location, the Apollo Program supply management system assumes responsibility and its purpose is to provide uniform and integrated activities in order to achieve maximum effectiveness in supply support at minimum cost. Supply functions include inventory control, storage, cataloging, distribution, shipment, disposal and financial management. The subsequent portions of Section 5.0 describe the requirements which are to be made a part of the supply management system.

5.1 Applicable NASA Documents

The following NASA standard management documents are applicable to the Apollo Program supply management system, and each NASA Center, test site and contractor will utilize the appropriate portions thereof, in developing, managing and controlling equipments, spare parts and supplies under their management jurisdiction.

a. For equipments and spare parts furnished as GFP-GFAE to contractors, the following documents are applicable:

   (1) NPC-400, Part 13, "Government Industry Property."

   (2) NPC-105A, "Property Control Manual."

5.1 (Cont.)

(3) ASPR Appendix "B," "Contractor Management and Control of Government Property." This document is authorized for use as an interim measure during the time span and until the NASA develops and disseminates for implementation a document of a comparable nature.

b. For equipments and spare parts owned and managed by NASA Centers and test sites:

(1) NMI 4020.1, "Survey of Lost, Damaged, Destroyed Property."

(2) NMI 4120.1, "Management of Store Stocks."

(3) NMI 4210.1, "Property Accountability."

5.2 Supply Management Controls

Apollo Program supply management controls will be established by each NASA Center's logistic function to maintain its program visibility for the development and implementation of an integrated supply management system. Supply milestone schedules concerning actions and procedures that require development and implementation are to be established, and they will portray interrelationships with other affected portions of the logistics system to establish complete program interface. NASA Centers will require reports on contractor schedules and status concerning their development and implementations of supply plans and procedures which are in support of the Apollo Program.

5.3 Integration of Supply Management System

Each NASA Center's Apollo Program logistics function will develop, establish and utilize effective and efficient methods for accomplishing inter-center liaison and coordination which will assure that the Apollo supply management systems, methods and practices of the Center's in-house, test sites and contractor organizations are integrated and program compatible.

5.4 Supply Support Plan

Each NASA Center's Apollo Program logistics function will develop and assure the establishment of a comprehensive supply support plan covering all of the supply item requirements for which its Center is responsible. These plans are to encompass all the supply actions necessary to effectively and economically manage and control MGE and spares support at Centers, test sites and contractor plants (inventory control; priority and routine requisitioning methods; accounting of assets due in; issue and turn-in of inventories; forecasting of replenishments; receiving and inspection; storage; engineering changes; modifications controls; etc.).

Further, these supply system plans are to be prepared in a manner and format which clearly portrays:

a. The time phased sequence of each supply system action, its associated time span and targeted completion date to be satisfied in order to assure timely supply system support.

b. The degree of plan execution and resultant supply system status against requirements.

c. Any required supply system planning and/or action adjustments necessary to maintain and/or provide plan consonance with program schedule requirements for supply support.

5.5 Administrative, Warehouse and Repair Shop Space

NASA Centers' Apollo Program logistics functions will establish methods for identifying, forecasting and controlling requirements for administrative, warehousing and repair shop space needed at Centers, test sites and KSC for the logistics support of the Apollo Program. The space requirements are to be predicted on peak numbers of personnel, equipments and spares which will be at these locations at any one time during the support life of the program.

5.5.1 The NASA Center's Apollo Program logistics function is responsible for assuring that each of its contractor space requirements for government furnished facilities at Centers, test sites and KSC are adequate and combined with the total Apollo Program space requirements at these locations. In addition they are responsible to perform a comprehensive review of space requirements on an annual basis. In consonance with paragraph 5.2 above, both MSC and MSFC Apollo Program logistic functions will coordinate and definitize with their counterparts at test sites and KSC, the space requirements required by their Centers and contractor organizations at test sites, MILA and the Kennedy Space Center.

5.5.2 The Apollo Program Centers' logistics functions are responsible to identify and document their parent Centers' in-house and test site supply support services and functions which are of a common nature that can be programed and made available for contractor use in order to preclude development by contractors of duplicate or redundant supply support services and functions at Centers and test site locations. These supply services include but are not limited to:

a. base central receiving and inspection,

b. base transportation, telephone and communication services, printing plants,

c. base warehousing,

d. base repair shops, telemetry and calibration services,

e. pneumatic fuels and propellant storage and services,

f. common supplies and

g. bulk and standard repair parts, etc.

5.6 Inventory Management

Apollo Program contractors are to be required to submit their plans, methods and procedures for integrating and controlling end items, equipments, and spares in their custody at factory, test sites and KSC. These documented methods and procedures are to encompass the techniques for configuration accounting, identifying, controlling and reporting the status of equipment and spares. In addition, these procedures are to contain the time span which will be employed to supply a part from store rooms at test sites and KSC, and in cases where spares are not in stock, the priority system and time to be used for acquiring the part from other sources is to be definitized.

5.6.1 Apollo Program contractors are to be required to establish and maintain inventory levels and reorder points as a part of their inventory management responsibilities. These inventory levels and reorder control points are to be closely controlled and time phased to be consistent with probable demand frequency so as to assure minimum spares inventory, but enough to satisfy current approved forecasts of program spares support requirements.

5.6.2 NASA Apollo Program organizations at Centers and test sites will be furnished contractor bulk and standard item requirements. NASA organizations are responsible for the management of a centralized site supply system that has the capability to respond to the site contractor requirements within time frames precluding program schedule delays or extra program costs.

5.6.3 Apollo Program contractor stock room procedures at test sites and KSC are to cover such responsibilities as inventory control, receipt, storage and issuance of spares and modification kits to support their products. In addition, they will include recalibration and shelf life replacement schedules for spares in stock

5.6.3 (Continued)

in a manner which is in consonance with the provisions of the Apollo Metrology Requirements Manual. Further, stock room management personnel are to be required to maintain due cognizance of test programs so that changes in supply system requirements can be anticipated and appropriate action initiated on a timely basis.

5.6.4 Apollo Program contractor inventory records at Centers, test sites and KSC will include the level and location of repair for reparable parts. Reparable parts are to be returned to the contractor stock room accompanied by a failure report, a reparable tag and any other required documents. These reparables are to be inspected and the part shipped to its designated repair site in the most expeditious manner. The contractor stock control unit will maintain a status record and follow-up to ensure repair completion on all parts in accordance with support requirements. On shipment of reparables from a stock room to repair site, accountability will be transferred from the consignor to the consignee.

5.6.5 Apollo Program contractors will be required to maintain daily stock balance and consumption reports at factory, test sites and KSC. These reports are to cover all stock transactions where parts are either received or withdrawn from stock.

5.6.6 Apollo Program contractors will be required to maintain a master property accounting and stock record cnetral data bank at their factories. This data bank will cover MGE and spare parts stock balance data for factory, test sites, Centers and KSC. Transactions affecting the stockage position at any one of the Apollo Program stock rooms will be communicated on a daily basis to the central data bank and the master records updated accordingly.

6.0 OPERATIONS AND MAINTENANCE INSTRUCTIONS

This section delineates the requirements for identifying, developing, providing and maintaining an integrated system of explicit and easily understood documented instructions which specify the manner in which the program's human and material resources will be applied to accomplish operations and maintenance on the Apollo Program AVE, AGE and facilities at the test sites, KSC and flight mission support and recovery locations.

Program operations and maintenance instructions requirements will be identified by analyzing the descriptive personnel task data provided by the logistics baseline, the maintenance requirements analysis and the logistics requirements information summaries described in Part II, paragraph 1.0, 2.0 and 3.0, respectively, and will be in consonance with applicable safety rules and regulations and all equipment and facility design specifications and limitations.

The format, technical content, and wording used to express the program's operations and maintenance instructions will be developed and tailored to the capabilities of the specific skill levels of their intended using personnel as specified by the personnel requirements portions of the logistics baseline and maintenance requirements analyses. In addition, instructions will, where suitable, use and reference commercially available manuals, technical manuals and microfilm data and be prepared in a format which can be inserted in and rapidly retrieved from an EDP system. Manual type, format, content and preparation are discussed in further detail in the following paragraphs.

6.1 Types of Operations and Maintenance Instructions to be Provided

Operations and Maintenance Instructions will be divided into types according to purpose and usage. Those types will generally fall into the following categories:

6.1.2 Apollo System General Description Instructions

Apollo Program instruction documents describing all program systems will be developed and provided. These instructions will cover the spacecraft and each of its modules, the launch vehicles and stages thereof, the instrumentation unit, and the operations ground equipment (OGE). These instructions will be developed from logistics baseline analysis data and limited to that necessary to provide a comprehensive orientation for the operations and maintenance personnel.

6.1.3 System Activities and Operations Personnel Task Instructions

These instructions will describe the specific manner in which all functions performed on, or in direct support of, elements of the integrated Apollo Program System are to be conducted. Task oriented data will be required to support a specific task or major activity such as assembly and checkout, test, transport, assemble, handle and launch. Supporting activity checklists and procedures will be packaged separately for use at different locations and levels. All instructions will be cross-referenced for expedited and integrated usage.

6.1.4 Inspection Requirements Instructions

Inspection requirements will identify scheduled inspections, maintenance, calibrations, and replacements of systems equipments and/or components in accordance with the maintenance requirements analysis outputs.

6.1.5 Systems Maintenance Instructions

Systems-oriented maintenance instructions are to provide procedures by which personnel will conduct maintenance of the major functional systems. These instructions will be derived from outputs of the operations and maintenance activities

6.1.5 (continued)

requirements analysis forms, operations and maintenance activities flow forms and design criteria forms.

6.1.6 Equipment Instructions

Equipment-oriented instructions are to provide procedures by which personnel will conduct operations and maintenance on AGE and second level maintenance of reparable items. The requirements for these instructions will be based on the outputs from the logistics baseline and maintenance requirements analyses for the particular piece of equipment.

6.1.7 Parts List Instructions

Parts Lists will be equipment-oriented parts breakdowns which are in consonnance with the maintenance requirements analysis outputs and spare parts provisioning. In cases of complex equipment, the parts list will be an illustrated parts breakdown. In most cases this data will form a part of the Equipments Instructions described in 6.1.6.

6.1.8 Commercial Manuals and Data Packages

Available commercial data will be evaluated for use in satisfying instruction requirements. Before using same as program instruction material, it will be reviewed for accuracy, adequacy, and usability. Evaluation of the adequacy of this data will be based upon the maintenance requirements analysis outputs and their specified usage requirements. Approved commercial data will be assigned an instruction identification number and listed in a Center-oriented Instruction Index.

6.1.9 Checklist Instructions

Operating or maintenance procedures contained in the task instructions will be supported by systematically structured

6.1.9 (continued)

checklists to be used as a check-off sheet by operating personnel to assure the proper accomplishment of each task involved in their associated instruction procedures.

6.1.10 Refurbishment Instructions

These instructions will provide procedures covering the accomplishment of normal refurbishment of the test and operational sites after test firings and launch operations. Instructions will be included for replacing or restoring reparable equipment damaged during launch.

6.2 Identification of Operations and Maintenance Instructions Requirements

The logistics baseline and maintenance requirements analyses documentation and outputs described in this Plan, Part II, Sections 1.0 and 2.0 will be used as the principal means of identifying the program operations and maintenance instruction requirements. Applicable program safety and site operating ground rules are to be used in conjunction with the above documentation to assure that all of the program's instruction requirements are identified. The manner in which the logistics baseline and maintenance analyses documentation is to be used for instruction requirements identification is described below.

6.2.1 AVE Activities Flow Diagrams

The AVE activities flow diagrams provided by the logistics baseline will be used to determine the instructions' overall coverage requirements and are to be used to assure the complete and non-redundant identification of activities instruction requirements. This is to be accomplished by a thorough

6.2.1 (continued)

analysis of the diagrams' described activities to assure that provisions are made for their required coverage and by integrating repetitive instruction requirements.

6.2.2 AVE Operations Flow Sheets

The AVE operations flow sheets expand the activities of the above described flow diagrams into the detailed operations essential to their proper accomplishment. The instruction requirements block on these sheets specify each described operation's instruction coverage requirements. Those coded "R" require the development of new instruction material. In cases where existing instructions cover an operation, these covering instructions are referenced by their code number. When the operation is of a simple nature not requiring additional description, they are used directly as personnel instruction material and are noted by "NR" on the flow sheet.

6.2.3 Maintenance Activities Analysis Sheets

The maintenance activities analysis sheets are equipment end item or equipment systems oriented. These maintenance activities analysis sheets describe the specific maintenance activity sequencing required starting with an equipment end item's or system's malfunction and continue through their required activities for fault isolation, repair, repair verification, and return of the end item or system to a serviceable (operational) status. Each sheet's maintenance instructions requirement block is completed in the same manner as those contained in the above described AVE operations flow sheets and are to be used accordingly by instructions preparation personnel.

6.2.4 Requirements Analysis Sheets

These sheets identify the OGE and MGE technical requirements in functional terms for each operation and the personnel skills and skill levels required to perform each personnel task. This information is to be used in preparing instructions to expand on the above equipment operations and personnel tasks. Instructions preparation personnel are to tailor the amount of instruction detail, technical content, and employed wording to the task's specified skill levels.

6.2.5 Design Criteria Sheets

The design criteria sheets provide the basic OGE and MGE performance specifications needed for their design. This information provides further detailed information to supplement the operating and maintenance instructions for the OGE or MGE equipment.

6.3 Organization and Grouping of Instructions Requirements

Instruction requirements covering program operations and maintenance activities and personnel tasks will be grouped according to their functional application, i.e., equipment system, site location, end item equipment, etc. Those instruction requirements associated with more than one functional application will be evaluated to determine if they should be incorporated into one set of instructions which are to be used for each of the functional applications or whether they are to be incorporated into specialized instructions prepared for each of these functional applications. Instruction requirements shall be grouped if this grouping can be accomplished without loss of instruction clarity or without jeopardizing program personnel and/or equipment safety or program schedules. When grouping instruction requirements, the point of group

6.3 (continued)

separation will be at the interface point between the major system or equipment technical functions (i.e., flight control system, handling system or equipment access, propulsion system, telemetry system, etc.), areas of operation, or organizational responsibilities. For example, all instructions covering a space vehicle's countdown phase will be grouped.

6.4 Instructions Requirements Form

After determination of the detailed instruction requirements, as described in paragraph 6.2, and organization and grouping of these requirements, as described in paragraph 6.3, an Instructions Requirements Form, Figure 6.4-1, will be required for each group of instruction requirements as follows. Illustrative samples of completed forms are shown in Figures 6.4-2, -3 and -4.

6.4.1 Data Identification

a. Title (Proposed)(1) - Enter the proposed title for the Instruction to be prepared.

b. System Identification (2) - The Apollo Program system and/or equipment covered by the instruction.

c. Type of Instruction (3) - The type of instruction, as described in paragraph 6.1, will be entered.

d. Effectivity (4) - Enter the location where the instruction is to be used (MTO, MSFC, KSC, KSC/VAB, MSC, SACTO, etc.)

6.4.2 Contract Information

a. Contractor and/or Vendor (5) - Enter the name of the Apollo Program contractor and/or vendor responsible for the instruction's preparation.

b. Contract (6) - The contract, approval letter or other notification to proceed with instruction preparation will be noted. This will be entered as a firm contract number after final approval of instruction development.

c. Exhibits and Specifications (7) - Include a list of the applicable exhibits and specifications used in development of the instructions.

d. Requirements Form Date (8) - Enter the form's initial release data by the preparing agency.

e. Change Data and Letter (9) - Enter form change dates and change letter identification for each date the Requirements Form is revised. The change letter will clearly identify each change throughout the form.

f. Delivery Schedule (10) - Show schedule for delivery by calendar date, or relation to another directly associated scheduled program event.

6.4.3 Requirements (11) - This will include instructions requirements information as follows:

a. Reference the requirements analyses or other source documentation used in developing the instructions data. This will include all areas described in paragraph 6.2.

b. A list of all equipment, by program element number covered by this instruction.

c. A list of all operations and/or maintenance activities, by activity reference number, as covered by the form's instruction material.

6.4.3 (continued)

d. Additional remarks, as needed, to better indicate the scope of the instruction.

e. List required source data or interface data from other contractors or government agencies.

6.4.4 NASA Approval (12)

For NASA use only - Enter NASA recommendations for change, approval or disapproval. Approved title and identification number of instruction and authorized approval signature will be included.

6.5 Preparation of Operations and Maintenance Instructions

The instructions will be prepared from the information described in paragraph 6.2 and in accord with the approved requirements of 6.3. In addition, existing current design, calibration, test, illustration, specification and equipment drawing data will be utilized as a basic part of the instruction material. Additional material shall be prepared as necessary to provide complete instructions compatible with the operations and tasks to be performed. For verification purposes, the instructions will be prepared in format and content similar to utility-type manuals. Instructions intended for operational use at KSC will be of a format and content established by the NASA organizations in accordance with the implementation requirements of Part I, Section 8.0.

6.6 Quality Assurance

A quality assurance program will be established to ensure that instruction format and content are compatible with equipment and personnel requirements. (Reference NPC 200-2).

6.6. (continued)

The preparer will establish quality control checklists which will be used to ensure that the instructions are consistent with equipment design specifications, operations and personnel tasks. The quality assurance program will provide for instruction verification on the systems and equipment covered by the instructions. The program will also provide for adequate configuration control accountability records to maintain current identification of all equipment and facilities to be covered by program instructions.

The instructions' quality assurance program will provide for records of all verfication and configuration control actions and will include schedule status. Each instruction will include a complete list of the applicable engineering changes. The NASA organizations will insure that these changes are released to the instructions preparation personnel within a time-frame that will allow use of these instructions in consonnance with hardware need dates.

6.7 Instructions Review

Reviews of the contractor's prepared instructions will be conducted at least once during their preparation and again upon completion. These reviews will assure the technical accuracy, instruction clarity, and appropriateness of instruction format to overall program requirements. A checklist system will be developed and established for these reviews which will ensure compatibility with standard instruction practices, proper use of the requirements analysis and other criteria which defines technical content, configuration control, and compatibility with model specifications.

6.8 Instructions Verification

Verification is the method by which specified procedures or instructions are demonstrated to be correct, usable, and compatible with equipment operations and personnel tasks. Verification will be limited to those operations and maintenance activities critical to launch and will be performed at test locations, whenever their equipment configurations permit this to be accomplished prior to the time that the instructions are used in the KSC operational environment. Verification of the instructions will be conducted step by step using the equipment required by the activity, operation, and personnel task procedures. Acceptable verification is obtained only when demonstration of the procedure results in successfully accomplishing the objectives of the activity, operation and personnel task. Each NASA Center will designate qualified personnel to be responsible for approving and documenting verification requirements and accomplishment.

6.9 Instructions Distribution and Control

Distribution and delivery of instructions will be based upon systems and equipment use schedules and locations. NASA organizations are to establish the methods within their Operating and Maintenance Instructions Program by which they will maintain instructions distribution, scheduling, funding and status control. They will ensure that each of their associated contractors have an instructions program within his logistics organization that will accomplish the provisions of this instructions requirements section. NASA organizations will provide a review of instructions schedules, funding and status to the Apollo Program office every 90 days. Contractors will provide schedule and funding status reports to their respective NASA Center every 30 days.

INSTRUCTION REQUIREMENT FORM

TITLE (PROPOSED) ①		CONTRACTOR AND/OR VENDOR ⑤	
SYSTEM IDENTIFICATION ②		CONTRACT ⑥	
TYPE OF INSTRUCTION ③	EXHIBITS AND SPECIFICATIONS ⑦		
EFFECTIVITY ④	REQ. FORM DATE ⑧	CHANGE DATES & LETTER ⑨	DELIVERY SCHEDULE ⑩

REQUIREMENTS

☐ LOGISTICS REQUIREMENTS ANALYSIS REFERENCES AND/OR

☐ OTHER JUSTIFICATIONS (SOURCE DATA)

⑪

FOR NASA USE ONLY ⑫ NASA RECOMMENDATIONS	APPROVED TITLE AND IDENTIFICATION NASA NUMBER
	APPROVED BY DATE

FIGURE 6.4-1; SAMPLE INSTRUCTION REQUIREMENT FORM

INSTRUCTION REQUIREMENT FORM

TITLE (PROPOSED) Saturn V/X-IVB Propulsion Systems Manual			**CONTRACTOR AND/OR VENDOR** Douglas
SYSTEM IDENTIFICATION Saturn V, S-IVB Propulsion System			**CONTRACT** NAS 7-101
TYPE OF INSTRUCTION System Maintenance & Checkout	**EXHIBITS AND SPECIFICATIONS** TSD Exhibit & MIL-M-5474C/9864		
EFFECTIVITY KSC-VAB Launch Area	**REQ. FORM DATE** 3-31-65	**CHANGE DATES & LETTER** 6-15-65	**DELIVERY SCHEDULE** 6-1-66

REQUIREMENTS

☐ **LOGISTICS REQUIREMENTS ANALYSIS REFERENCES AND/OR**

☐ **OTHER JUSTIFICATIONS (SOURCE DATA)**

Equipment:

Prime: S-IVB Engine, Turbo-pumps, Engine valves, Ignition System, Heat Exchanger, Pre-valves, Pressurization Control Module, Cold Helium F, V Module

Support:

P.E.N.	Nomenclature
2251.33.01	Mobile Pneumatic Checkout Equipment
2251.33.02	Portable Pneumatic Regulator
2254.04.01	VAB Low Bay Pneumatic Test Kit
2232.02.01	Engine Handling Kit
2234.01.03	Aft Umbilical Kit LUT
(T.B.S.)	Checkout Accessories Kit 1A92953-1

Reference: D5-16000-122, dated 1 February 1965

Technical Requirements:

S-IVE Propulsion System Low Bay Checkout

8169.8181 Conduct functional check of engine valves

FOR NASA USE ONLY	**NASA RECOMMENDATIONS**	**APPROVED TITLE AND IDENTIFICATION NASA NUMBER**
		APPROVED BY **DATE**

FIGURE 6.4-2; SAMPLE INSTRUCTION REQUIREMENT FORM (SHEET 1 OF 2)

INSTRUCTION REQUIREMENT FORM

TITLE (PROPOSED) Saturn V/S-IVB Propulsion Systems Manual			**CONTRACTOR AND/OR VENDOR** Douglas
SYSTEM IDENTIFICATION Saturn V, S-IVB Propulsion System			**CONTRACT** NAS 7-101
TYPE OF INSTRUCTION System Maintenance & Checkout	**EXHIBITS AND SPECIFICATIONS** TSD Exhibit & MIL-M-5474C/9864		
EFFECTIVITY KSC-VAB Launch Area	**REQ. FORM DATE** 3-31-65	**CHANGE DATES & LETTER** 6-15-65	**DELIVERY SCHEDULE** 6-1-66

REQUIREMENTS

☐ **LOGISTICS REQUIREMENTS ANALYSIS REFERENCES AND/OR**

☐ **OTHER JUSTIFICATIONS (SOURCE DATA)**

8169.8185	Conduct turbo-pumps torque test
8181.8183	Conduct engine leak test
8183.8187	Conduct hot gas system leak test
8169.8186	Conduct S-2 ignition system functional test
S-IVB	Propulsion system in-place checkout
S-IVB	Propulsion system low bay maintenance
S-IVB	Propulsion system in-place maintenance Manual fault isolation actions Corrective maintenance instructions

(Additional detail requirements to be provided as identified by analysis)

FOR NASA USE ONLY	**NASA RECOMMENDATIONS**	**APPROVED TITLE AND IDENTIFICATION NASA NUMBER** **APPROVED BY** **DATE**

FIGURE 6.4-2; SAMPLE INSTRUCTION REQUIREMENT FORM (SHEET 2 OF 2)

INSTRUCTION REQUIREMENT FORM

TITLE (PROPOSED) Mobile Pneumatic Checkout Equipment Operation and Maintenance Manual			**CONTRACTOR AND/OR VENDOR** The Boeing Company
SYSTEM IDENTIFICATION Pneumatic (GSE)			**CONTRACT** NAS 8-5608
TYPE OF INSTRUCTION Operations and Maintenance	**EXHIBITS AND SPECIFICATIONS** MSFC, 10M01776A		
EFFECTIVITY KSC-MILA-VAB-Low Bay	**REQ. FORM DATE** 6-11-65	**CHANGE DATES & LETTER**	**DELIVERY SCHEDULE** 10-1-65

[X] **LOGISTICS REQUIREMENTS ANALYSIS REFERENCES AND/OR REQUIREMENTS**

[X] **OTHER JUSTIFICATIONS (SOURCE DATA)**

Equipment:

Mobile Pneumatic Checkout Equipment 2251-33.01
VAB Low Bay Pneumatic Test Kit 2254.04.01
2251.3302 Portable Pneumatic Regulation Unit

Reference: D5-16001-571, "Saturn V MGSE Maintenance Analysis"
Saturn V Master Equipment Record, Vol. IX
"LVGSE (MSFC furnished) by Program Element"

Technical Requirements:

2251.33.01	Mobile Pneumatic Checkout Equipment	
2251.33.01.01	Test Set Mobile Pneumatic Checkout 25A10024-101-11	Checkout Fault Isolation Repair - Checkout
	Circuit Breaker AM12MG6	Remove - Install - Handle
	Voltmeter 20A10021-101-11	Adjust - Remove - Install
	Switch MS25002-2	Remove - Install

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FIGURE 6.4-3; SAMPLE INSTRUCTION REQUIREMENT FORM (SHEET 1 OF 3)

INSTRUCTION REQUIREMENT FORM

TITLE (PROPOSED) Mobile Pneumatic Checkout Equipment Operation and Maintenance Manual			**CONTRACTOR AND/OR VENDOR** The Boeing Company
SYSTEM IDENTIFICATION Pneumatic (GSE)			**CONTRACT** NAS 8-5608
TYPE OF INSTRUCTION Operations and Maintenance	**EXHIBITS AND SPECIFICATIONS** MSFC, 10M01776A		
EFFECTIVITY KSC-MILA-VAB-Low Bay	**REQ. FORM DATE** 6-11-65	**CHANGE DATES & LETTER**	**DELIVERY SCHEDULE** 10-1-65

REQUIREMENTS

[X] **LOGISTICS REQUIREMENTS ANALYSIS REFERENCES AND/OR**

[X] **OTHER JUSTIFICATIONS (SOURCE DATA)**

	Switch P/N 8825K6	Remove - Install
	Roto-Tellite P/N 101-N-W	Remove - Install
	Lamp (2) MS25237-327	Remove - Install
	Roto-Tellite P/N 102-N-W	Remove - Install
2251.33.01.02	Pneumatic Checkout Console, Mobile 25A10028	Visual Check - Calibrate - Service Fault Isolate - Repair - Checkout Store - Inspect - Clean
	Gage, Pressure 20A10010	Remove - Install - Checkout
	Transducer, Pressure 20A10011	Remove - Install - Checkout
	Valve, Solenoid 20A10006	Remove - Install - Checkout
	Valve, Manual Inlet 20A10005	Remove - Install - Checkout
	Regulator, Dome Loaded 20A10009	Remove - Install - Checkout
	Valve Regulator 20A10004	Remove - Install - Checkout

FOR NASA USE ONLY	**NASA RECOMMENDATIONS**	**APPROVED TITLE AND IDENTIFICATION NASA NUMBER** **APPROVED BY** **DATE**

FIGURE 6.4-3; SAMPLE INSTRUCTION REQUIREMENT FORM (SHEET 2 OF 3)

INSTRUCTION REQUIREMENT FORM

TITLE (PROPOSED) Mobile Pneumatic Checkout Equipment Operation and Maintenance Manual			**CONTRACTOR AND/OR VENDOR** The Boeing Company
SYSTEM IDENTIFICATION Pneumatic (GSE)			**CONTRACT** NAS 8-5608
TYPE OF INSTRUCTION Operation & Maintenance	**EXHIBITS AND SPECIFICATIONS** MSFC, 10M01776A		
EFFECTIVITY KSC-MILA-VAB-Low Bay	**REQ. FORM DATE** 6-11-65	**CHANGE DATES & LETTER**	**DELIVERY SCHEDULE** 10-1-65

[ ] **LOGISTICS REQUIREMENTS ANALYSIS REFERENCES AND/OR REQUIREMENTS**

[X] **OTHER JUSTIFICATIONS (SOURCE DATA)**

2251.33.02	Regulation Unit, Portable Pneumatic 10A520148	(To be supplied at later date)
2254.04.01	Test Kit, Pneumatic 22A12005	Visual inspection, component proof test, replace

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		APPROVED BY **DATE**

FIGURE 6.4-3; SAMPLE INSTRUCTION REQUIREMENT FORM (SHEET 3 OF 3)

INSTRUCTION REQUIREMENT FORM

TITLE (PROPOSED) S-IC Intertank Umbilical Ground Carrier Control Test Operations & Maintenance Manual	**CONTRACTOR AND/OR VENDOR** The Boeing Company
SYSTEM IDENTIFICATION Saturn V Mechanical Ground Support Equipment	**CONTRACT** NAS 8-5608
TYPE OF INSTRUCTION Operation & Maintenance	**EXHIBITS AND SPECIFICATIONS** MIL-M-5474C, MSFC-10M01776

EFFECTIVITY	**REQ. FORM DATE**	**CHANGE DATES & LETTER**	**DELIVERY SCHEDULE**
KSC-MILA-VAB Low Bay	10-1-64		1 April

REQUIREMENTS

[X] **LOGISTICS REQUIREMENTS ANALYSIS REFERENCES AND/OR**

[ ] **OTHER JUSTIFICATIONS (SOURCE DATA)**

Equipment:

2211.08.02 S-IC Intertank Umbilical Ground Carrier Control Test Set 25-52374-1

Reference: D5-16001-571 Saturn V MGSE Maintenance Analysis
Saturn V Master Equipment Record Vol. IX "LVGSE (MSFC furnished) by Program Element"
Contract End Item Detail Specification, CP-2A 12001-101

Technical Requirements:

Test Set Assy. 25-52374-1 Visual Check, Checkout, Repair, Calibrate, Remove, Install

Cable Assembly 25-52684-1 Checkout

Remove & Install the following components:

Cable Assy. 25-52384-2
Rotary Switch MJ2500-2
Indicator 10E14-ALC2-J3-L(66WW)N2-R1
Roto-Tellite 101-NB
DC Micrometer Model 3911
Circuit Breaker AM 12J50DC-5
Indicator 10E14-ALC2-F135-J3-L(GGWW)N2-R1
Indicator 10E-LAC2-F1-J3-N1-R1
Relay, Time Delay 2122DH2NJ
Gasket 25-52385-1

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NASA RECOMMENDATIONS	**APPROVED BY** **DATE**

FIGURE 6.4-4; SAMPLE INSTRUCTION REQUIREMENT FORM (SHEET 1 OF 2)

INSTRUCTION REQUIREMENT FORM

TITLE (PROPOSED) S-IC Intertank Umbilical Ground Carrier Control Test Operations & Maintenance Manual			**CONTRACTOR AND/OR VENDOR** The Boeing Company
SYSTEM IDENTIFICATION Saturn V Mechanical Ground Support Equipment			**CONTRACT** NAS 8-5608
TYPE OF INSTRUCTION Operation and Maintenance	**EXHIBITS AND SPECIFICATIONS** MIL-M-5474C, MSFC-10M01776		
EFFECTIVITY KSC-MILA-VAB-Low Bay	**REQ. FORM DATE** 10-1-64	**CHANGE DATES & LETTER**	**DELIVERY SCHEDULE** 1 April

REQUIREMENTS

[X] **LOGISTICS REQUIREMENTS ANALYSIS REFERENCES AND/OR**

[ ] **OTHER JUSTIFICATIONS (SOURCE DATA)**

Resistor, Variable RVGLAYSA-253A
Resistor MIL-R55182 Type RNR-70C2502FM
Connector 10-323640-2068
Diode, Avalanche MIL-M-195001115BINJ026B
Resistor MIL-R-55182 Type RNR-70C1501FM
Resistor MIL-R-2ERWG7V201
Connector 10-323340-735

Source Data Requirements

Master Specialties Co., Cat. No. 2004
Agastat Timing Instruments
VSMF-14th issue - Dec. 1964 thru April 1965

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		APPROVED BY **DATE**

FIGURE 6.4-4; SAMPLE INSTRUCTION REQUIREMENT FORM (SHEET 2 OF 2)

7.0 APOLLO PROGRAM TRAINING REQUIREMENTS

This section describes the means by which Apollo Program training requirements for operations and logistics personnel at the test sites and KSC are to be identified, provided, controlled and managed. The elements required to accomplish these efforts include:

a. Personnel Training Requirements Analysis

b. Training Plans

c. Training Implementation

d. Training Management Control

Proper implementation and management of the actions called for by this section's provisions will assure timely and economical provisioning of essential training and training equipment for the Apollo Program.

A systematic analysis will be made of the logistics baseline and maintenance requirements analyses outputs to determine those program tasks requiring Apollo Program training. The training analysis output data will be used to develop training plans that will describe the methods to be utilized to obtain and/or provide required personnel training, and define modes of maintaining the developed personnel skills. Each NASA Apollo Program Center will require its associated major project contractors and/or program integration contractors to develop and implement operations and logistics personnel training programs as appropriate to cover those contractors' test site and KSC responsibilities. This activity will be in accordance with the provisions of this section. Implementation of required training will be through appropriate NASA Center approval of contractors' proposed training plan and/or issuance

7.0 (Cont.)

of a Training Equipment Provisioning Order (TEPO), (see paragraph 7.3.1.1) to the contractor. NASA management controls will be provided for all training requirements.

7.1 Personnel Training Requirements Analysis

The purpose of the personnel training requirements analysis is to identify training required to adequately prepare participating program personnel to operate and maintain program equipment items in a manner consistent with the high reliability and safety standards of man-rated space systems. This analysis will be conducted by a review of all operations and maintenance tasks of the logistics baseline and maintenance requirements analysis and relating it to the uniform set of training parameters defined in subsequent paragraphs.

In order to ensure the availability, consideration, and recording of all essential training analysis data, a form equivalent to that illustrated in Figure 7.1-1 will be utilized. Application of this form will give a precise correlation between the logistics baseline and maintenance requirements analysis data and personnel training requirements analysis data. Significant analysis data required includes:

a. Personnel types and quantities.

b. Training analysis data which defines:

   (1) Nature of required training.

   (2) Employee task certification requirements.

   (3) Nature of required training equipment.

Training course development will be personnel task oriented. Therefore, the training requirements analysis data will be accumulated by personnel code type and title as it appears in the logistics baseline and maintenance requirements analysis.

7.1 (Cont.)

The quantities of program personnel required for each skill category as provided by the logistics requirements summary information outputs (Section 3.0 of Part II), will also be recorded in order to have information available to determine whether it is more practical and economical to develop a specific course for a particular personnel skill category, or whether a training course will have to be developed and applied covering several allied personnel skill category training requirements. The analytical method used to perform this evaluation is to be documented as is the rationale used in arriving at a decision on these matters.

The following items of logistics baseline and maintenance requirements analysis data will be recorded to assure having adequate information upon which to make appropriate training analysis requirement judgments:

a. Data reference - operation number assigned to task being evaluated.

b. Equipment - nomenclature and the equipment's identifying program element number (PEN).

c. Task - Description of the specific methods by which assigned program personnel skills are to accomplish their functions.

d. Proficiency level - a coded level of required competency for task performing personnel perceptual skill, judgmental skill, and motor skill. Each task requirement will be appropriately rated using the following coding: 1 = low demand, 2 = medium demand, 3 = high demand.

e. Performance criticality - a coded level to indicate the potential effect of nonperformance or improper performance of a task. Coding will be: A = little or no effect,

7.1 (Cont.)

B = could result in some degradation of equipment but not affect mission success, C = mission success would be compromised to an unacceptable degree.

Based on a comprehensive and systematic review of the logistics baseline and maintenance requirements analysis output data, the following training requirements judgments will be made and recorded:

a. Training - The nature of training shall be:

(1) Orientation - Acquainting the trainee with the subject matter for purposes of establishing a background. The trainee will not be expected to perform any specific tasks as a result of such training.

(2) Task-based training - Presenting the subject matter for purposes of enabling the trainee to properly apply the knowledge obtained to actual job situations.

b. Certification - Because of their nature certain tasks will require certification and periodic re-certification of employee capability to perform such tasks. This determination is made based on the following factors:

(1) Personnel Safety - The operation or task could substantially endanger the operator or other personnel.

(2) Equipment Safety - The operation or task could potentially create fire, explosion or other hazard that would damage equipment or property.

(3) Reliability of an End Product - The operation or task if improperly performed would have substantially adverse effects on the reliability of the product.

(4) Destruct Verification - The operation or task can be inspected only by destruction of the part or end item.

c. Training Equipment - Based on the degree of criticality, certification, and nature of training required, the type of training equipment required will be identified as:

(1) Simulator - Equipment items that are developed to meet specific training objectives. Utilization of these items will enable development of general procedural skills.

(2) Operational Equipment - Equipment items which are built to the specifications of an actual operational system. Utilization of these items will enable development of exact unique skills.

(3) Training Aids - Items such as charts, slides, cutaways of equipment, films, transparencies, etc.

The personnel training requirements analysis data is to correctly identify specific characteristics of required training and training equipment. This data will be the basis for the judgmental decisions required for defining the necessary training courses and training equipment described below:

a. Training Courses - Training requirements for an individual personnel skill type will be grouped considering functions, general skill requirements, equipments used, and job location to broaden the areas of training required. Combining all groupings for a personnel skill type on an equipment oriented basis will provide a training outline for that personnel skill type. Personnel skill type training outlines will be compared for functions, skill descriptions, equipment operated or maintained, and support equipment used for operation or maintenance to

7.1 (Cont.)

enable identification of an appropriate training course. Personnel utilization plans containing schedules, quantities, and job location will be evaluated in determining final training course design.

b. Training Equipment - Grouping individual requirements from the personnel training requirements analysis outputs by the identifying program element number will summarize the need for a particular item of training equipment. A review of the objectives of training courses will be performed to determine when it is to the Government's advantage to combine several items of training equipment to meet a particular objective. NASA organizations are responsible to see that such evaluations are properly conducted and utilized. Details for recording pertinent training equipment design criteria data are given in paragraph 7.3.

7.2 Training Plans

Training plans will be prepared to provide documented sources for identifying required Apollo Program training courses, resources and management controls as needed to assure achieving Apollo Program training requirements. Contractor training plans will be developed and integrated into NASA Center Program training plans. These plans are described in the following paragraphs:

7.2.1 Contractor Training Plans

The contractor training plans will document proposed methods for satisfying training requirements identified in consonance with the personnel training requirements analysis outputs. Each plan will be developed along the guidelines detailed in the following paragraphs:

a. Introduction - This section will define the program area covered by the plan.

b. Requirements Summary - Quantity, types, and location of personnel to be trained as a function of calendar date will be summarized.

c. Training Courses - Definition of recommended training courses will be included in a training plan by means of the Course Description and Course Outline as described below:

A Course Description is the basic organization material for a course. This data will be presented in a format similar to that shown in Figure 7.2.1-1. A course Outline is an itemized listing of each subject to be presented in a course with the time element devoted to each subject. The Course Outline will serve as the basis for developing training materials such as lesson plans, training aids, and student projects during training implementation.

Recommended courses will be identified as to whether they are required to be developed as new courses or whether other existing or planned courses can be satisfactorily used or modified to fulfill the training needs. These systems courses will be identified to meet the requirements of personnel skill types. The application of electronic data processing techniques in conjunction with personnel type codes will facilitate identification and consolidation of training requirements data in terms of training courses. Data developed through Section 6.0 of Part II (Apollo Program Operations and Maintenance Instructions) will be considered in recommending training courses either as sources of training information or as complimentary data for required training functions.

d. Training Equipment - Training equipments will serve as aids to develop system knowledge, general procedural skills, and exact unique skills. Training equipment required to support training on individual tasks shall have been identified by equipment category in satisfying the personnel training requirements analysis provisions. The categories of training equipment are training aids (e.g., charts, slides, cutaways of equipment, films and transparencies), simulators which will meet specific training objectives, and operational equipment.

Specific recommended training equipment will be identified by means of Training Equipment Design Criteria Analysis and Training Equipment Utilization Analysis as described below:

(1) The training equipment design criteria analysis will be prepared by grouping those requirements of a particular item of equipment identified by a single program element number and nomenclature (program element). Training aid requirements are not included in the training equipment design criteria. Figure 7.2.1-2 shows the format that is to be used in making this analysis. Program element nomenclature and number, data reference, task, personnel code type, and trainer type are items of data provided by satisfying provisions of the personnel training requirements analysis. The design approach will be a narrative description of the required item of training equipment which integrates the previously listed training equipment requirements. It will be headed by a descriptive title.

(2) The training equipment utilization analysis will be made to determine whether a recommended item of training equipment should be built or if alternate means, such as use of test and development facilities, can be utilized. Figure 7.2.1-3 shows the format that is to be used in making this analysis. Use of a training equipment item in a particular course is determined by comparing the personnel type code on the training equipment design criteria form with the personnel type code on the course description and by reviewing that course's training requirements. Student loading will be derived from the number of personnel listed on the personnel training requirements analysis.

The training equipment section of the training plan will include a summary study to evaluate recommendations for provisioning of training equipment. Factors to be considered are cost, utilization, provisioning schedule, location, task criticality, availability of test and development facilities, existing training equipment, and utilization schedules.

e. Schedules - Schedules will be a part of the training plan. These schedules will be compatible with and derived from the latest Apollo Program schedules. As a minimum, schedules will include data relative to trained personnel need dates, provisioning dates for individual training courses, and provisioning and utilization dates for training equipment including test and development facilities.

f. Interface Requirements - Any training interface requirements between contractors or programs will be identified with adequate justification relating it to the individual contractor personnel training requirements analysis.

Training required by a contractor from another contractor for development of his personnel skills will be identified as Government Furnished Training. These requirements will be presented in the format shown in Figure 7.2.1-4. An estimate of training to be provided to other Centers or contractors will be included.

g. Training Compatibility Management - A section of the training plan will include a method for NASA management reviews of each training course and/or training equipment to assure their compatibility with associated Apollo Program elements and schedules. These management tools will consider application of electronic data processing techniques.

h. Training Program Evaluation - A system of measurement will be devised and implemented which will assure a continuing and accurate comparison between resultant trainee proficiency on the job and training course objectives. The system of measurements will include evaluation during training and performance on the job. Changes to the training courses will be made based upon these performance measurements. Participating NASA organizations will provide a system for obtaining training program status and adequacy.

i. Certification - All training leading to certification of personnel engaged in the performance of critical operations will be described as a part of a formalized method for certification. The decision to select certification as the means of control shall be in consonance with the personnel training requirements analysis. Contractors will determine the certification and periodic re-certification requirements for those critical tasks peculiar to the Apollo Program test, development operation and

7.2.1 (Cont.)

maintenance activities. Certification is applied only to those tasks identified by or deemed critical by the contractor and concurred in by their cognizant NASA Center.

j. Training Development Estimate - An estimate of the total resources required to develop and implement a training plan will be contained in the plan and will consider time-phased instructor requirements supported by training schedules, administrative support requirements, training equipment requirements supported by need dates, facility requirements such as special utility and power requirements, services and data required from other contractors and/or NASA, and travel of instructors or trainees to and from the training location.

7.2.2 Program Training Plan

A program training plan will be provided and will be based on approved contractor training plans. It will give visibility on total Apollo Program training requirements and will indicate cross-training capabilities from system to system and program to program. This plan will consist of:

a. Contractor Responsibilities - Technical and program areas of responsibility will be clearly defined for the various contractors.

b. Program Cross-Training - Training required by one program from other programs, and training to be furnished by one program to other programs will be enumerated and responsibilities for providing the training will be defined.

c. NASA Test and Development Facilities - Use of existing test and development facilities in fulfilling training requirements will be detailed. This will include precise training use schedules, student quotas, use purposes, and availability status to other programs.

7.2.1 (Cont.)

d. Training Equipment - A complete identification of that training equipment which meets a program requirement rather than an individual contractor's requirement will be made. Responsibility for development and utilization of training equipments will be defined.

e. Schedules - Schedules which reflect program training activities will be prepared in consonance with over-all Apollo Program requirements.

f. Program Controls - Controls necessary to provide for the implementation of the program training system will be included.

7.3 Training Implementation

Each NASA organization will implement the training plans, described in 7.2, by appropriate contractual action. The preparation for and actual conduct and evaluation of training will consist of a detailed preparation and presentation of the courses identified in the approved training plans, utilization of training equipment and/or test and development equipment/ facilities in the courses identified in accordance with 7.1, measurement of knowledge or skill developed by training and its application as specified in 7.2., and design, fabrication and use of training equipment identified in 7.1. The training equipment provisioning, design and demonstration are covered in the following portions of 7.3:

7.3.1 Training Equipment Provisioning

Each Center will provision training equipment in accordance with the requirements of this section. These requirements establish the controls applied in developing training equipment specifications. All items of training equipment will be entered in the program element numbering system to help assure their proper configuration control and consonance with all program equipment procurement. A Training Equipment Provisioning Order (TEPO) will

7.3.1 (Cont.)

be utilized and will include the information shown in paragraph 7.3.1.1. Fabrication of training equipment will occur after the cognizant NASA Center approves the various training equipment specifications and final decision to provide training equipment is made by this Center. Interim training equipment order release systems are to be established to permit selected program contractors to initiate production and/or acquisition of their associated training equipment critical spares or other material requirements. This will be accomplished in advance of completing the equipments' normal provisioning process when and if such interim order releasing is essential to satisfy established program training requirements concurred in by the cognizant NASA Center. Program contractors who are allowed to exercise interim release procedures are to be required to cover each interim release action with a documented analysis which conclusively justifies the interim release action. These contractors are to be required to make these analysis documents available for NASA review within 15 working days after the interim release action. NASA Apollo Program organizations are required to perform systematic critical reviews of all their associated contractors' interim release activities on a periodic basis which is not to exceed 60 calendar days. The interim release systems are to encompass instructions to the contractor for priority action to identify, prepare specifications for and begin fabrication of long lead time items to assure timely availability of the equipment for training purposes.

The TEPO will be contractually applied as the definitive instrument covering development of specifications, design and fabrication of training equipment. No contractor efforts are to be directed towards the design or development of training equipment prior to receipt of an approved TEPO from their cognizant NASA Center.

7.3.1.1 Training Equipment Provisioning Order (TEPO)

The purpose of the TEPO is to provide technical contractual direction and authority to a contractor to develop training equipment. A separate TEPO will be prepared for each item of training equipment; however, NASA Apollo Program Centers may authorize combining specifications of simple trainers into a single specification by the same manufacturer. In this event, specific instructions will be forwarded by NASA to the contractor. The TEPO will be prepared and issued by the responsible NASA Center and will contain, as a minimum, the information delineated below. The receiving contractor will, in response, be required to proceed with training equipment specification development in accordance with the instructions of the TEPO.

a. Program or Project Identification.

   The program or project to which the training equipment applies will be shown (e.g., Apollo/Saturn V, S-IC stage).

b. Training Equipment Name, Identification Number and General Description.

   The name of the training equipment and its program element number will be provided as will the description and purpose of the training equipment.

c. Responsible Contractor.

   The full name and address of the contractor who will respond to this TEPO will be given as well as the contract reference number.

d. Technical Requirements.

   (1) Functional requirements description: A complete account of the functional capability required of the training equipment will be provided.

(2) Trainer quantity and delivery instructions: The number of separate trainers required will be shown. Delivery instructions will be provided covering packing and crating specifications, maximum G-force limitations in transit, place of delivery, etc.

(3) Delivery Dates: Required delivery dates of training equipment at the delivery location will be given.

(4) Directions for selection of training equipment spare parts: This part will explain the spare parts methods (i.e., from vehicle support inventory, etc.), of obtaining one-of-a-kind or "training peculiar" parts, and other information which relates to the spare parts support of the training equipment.

(5) Definition of bench items, special tools, test equipment and support equipment required: This paragraph will describe the common and special equipment required to inspect, maintain, repair and support the training equipment involved.

(6) Criteria for use of reject or non-operable parts in trainers will be provided to the contractor. Any rejected or non-operable part may be used if it satisfies the trainer specification requirements. Rejected or non-operable parts consist of such items as inspection reject items, model test salvage, production sample test items, test excesses, etc.

(7) Instructions for development of training equipment operation and maintenance instructions: Includes specifications for training equipment operation and maintenance instructions, number of copies required, requirements for periodic revision, need dates, etc.

7.3.1.1 (Cont.)

(8) Installation, checkout and acceptance demonstration requirements: Specifies the procedures to be followed in installing and preparing the training equipment for operation. It also specifies procedural and functional demonstrations required to demonstrate training equipment conformance to design specifications.

e. Training Equipment Specifications Development Schedule and Submittal Instructions.

Establishes milestone dates for development of equipment specifications and provides reporting data such as frequency of periodic reports, format, specific data requirements, etc.

f. Training Equipment Guidance Meeting Requirements and Schedules.

Shows the schedule for guidance meetings established by NASA. All aspects of the contractors' activities which relate to information contained in the TEPO will be reviewed at these meetings.

g. Modifications and Configuration Status Change Requirements.

Establishes the requirements of the contractor to modify training equipment to maintain compatibility with the operational program equipment (Reference NPC 500-1).

7.3.2 Training Equipment Performance and Design Specifications

Proposed training equipment performance specifications will be developed by program contractors and submitted to their associated NASA Center for approval within 60 days after contractor receipt of the TEPO. It will consitute the early visibility of training equipment development recommendations and performance

7.3.2 (Cont.)

characteristics from which the NASA Center can evaluate schedules, effectivity and budgetary considerations, and provide additional direction (including TEPO changes) to the contractor as necessary.

The specification will include as a minimum, detailed descriptions of the items delineated below:

a. Training Equipment Definition - The purpose and scope of the training equipment will be stated. A statement of the intended use by courses and personnel types to be trained with this training equipment will be included. The training equipment nomenclature and number will be given. The Program Element Number and Program Equipment configuration reflected by the training equipment will be specified.

b. Applicable Documents - Operational equipment documents used to define the trainer design and layout, and training plans used as a guide for trainer development will be listed.

c. Performance Requirements - The following areas will be covered:

(1) Training Situation - This will delineate operation and/or maintenance functions to be taught using this training equipment and the location of operational equipment upon which these functions shall be performed. The specific tasks to be learned by students will be listed with reference to other training or operational equipment to be used with this training equipment in covering these tasks. Identification of tasks covered that require simultaneous student participation at different work stations will be made. The maximum number of

students that can be efficiently trained simultaneously will be given.

(2) Design Description - This description will include identification of major units of the training equipment and their functional relationship to each other and to the represented operational equipments; how simulation of operational equipment will be accomplished; special features of the training equipment which make it more flexible as a training device than the operational equipment which it reflects; provisioning for fault insertion and sequence interruption as a training device; identification of features which are applicable to human engineering requirements; training equipment maintenance requirements and indication of major items required for spares that have long procurement times; and design features which will allow for modification of training equipment systems or subsystems to later system model series.

(3) Construction - List the required components for construction of the training equipment; operation of the training equipment in an instructional situation; and assembly or test of the training equipment prior to and/or during training equipment installation.

These items of equipment will be designated as contractor furnished, or government furnished by expected source. The approximate dimensions of the major items of the training equipment will be given. Facility requirements such as training equipment space requirements, total training equipment weight, and utility requirements will be specified.

7.3.2 (Cont.)

(4) Installation and Checkout Requirements - Training facility requirements for assembly and checkout will be specified.

(5) Trainer Logistics Support - Determination of the human and material resources required for conducting maintenance of the training equipment will be accomplished by a maintenance requirements analysis technique identical to that described in Section 2.0 of this Plan, Part II. Acquisition and control of these logistics resources will be accomplished in consonance with the provisions of Sections 3.0, 4.0, 5.0 and 6.0 in this Plan, Part II.

(6) Quality Assurance - List any design, test or acceptance specifications to be produced.

(7) Budget Estimate - The budget estimate will be submitted with a cost breakdown sufficient to use as an evaluation factor by the NASA Center in determining whether subsequent authority will be granted to proceed with a design specification.

(8) Training Equipment Development Schedule - Indicate the key milestones in training equipment development. The schedule will clearly define delivery dates, need dates, design completion dates, fabrication schedule, installation and checkout schedule, acceptance dates and relationship to program schedule.

The final training equipment design specifications are to be developed and established which incorporate the essential prime requirements of the training equipment performance specification and more detailed design requirements data. It will be developed by the training equipment contractor upon receipt of an approved

7.3.2 (Cont.)

training equipment performance specification and submitted as prescribed by the schedule in the applicable training equipment design specifications will clearly define the following:

a. Training Equipment Description - Provide a detailed narrative description of the major sections and components included in the training equipment. The objective of the training equipment with the training activities it supports will be described. Features of the training equipment which make this piece of equipment a uniquely instructional device will be delineated.

b. Specifications and Standards Selection Criteria - Provide a description of the means used to select training equipment specifications and standards selection criteria.

c. Design Criteria - The same design specification criteria for all program equipment as covered in NPC 500-1.

d. Cost Data - A cost breakdown will be submitted to use as an evaluation factor by the NASA Center in determining whether subsequent authority to proceed with training equipment fabrication will be granted.

7.3.3 Training Equipment Demonstration Specification

Training Equipment Demonstration Specifications will be developed and established which delineate the demonstration requirements for satisfying the objectives of training equipment performance as defined by the approved preceding specifications and TEPO. The objectives of the training equipment demonstrations defined by this specification are to:

a. assure conformance of training equipment fabrication and manufacturing techniques with the specifications and quality assurance standards defined in the TEPO.

7.3.3 (Cont.)

b. determine the ability of the trainer to perform all tasks required to accomplish the general and specific training objectives of the training equipment performance specification, and training equipment design specification.

c. permit the early identification of problem areas and deficiencies that can degrade the Apollo Program effectiveness of the training equipment in order to permit timely corrective action.

7.3.3.1 Requirements for meeting training equipment demonstration objectives will include:

a. tests that will be performed on the equipment including the criteria to be used.

b. the manner by which the training functions of the training equipment will be demonstrated.

c. a list of demonstration test data to be collected.

d. a list of the demonstration procedural guides, and specific operation and maintenance instructions or technical manuals that will be used.

e. location of the trainer demonstration.

Applicable documents such as trainer performance specification, trainer design specification, drawings, operational equipment manuals, etc., will be listed.

7.4 Training Management

Each NASA Center will implement and maintain effective Apollo Program training management controls. These controls will be defined in released directives, instructions and procedures and will cover:

a. Organizational Responsibilities

This element will provide a clear definition of assigned responsibilities and authority for all facets of logistics

training within that Center, including all technical development, review, approval, contracting, budgetary, and fiscal requirements.

b. Contractor Responsibilities

The NASA training management controls will provide concise direction to the contractors in a manner that will clearly define that contractor's training responsibilities and assure that all required training is contractually covered in a non-redundant manner. Contractor responsibility descriptions and direction to the contractors will be definitive to the extent that they can be readily incorporated into incentive-type contracts on a sound contractual basis.

c. Training Effectivity

The responsibilities and techniques of training and training equipment configuration monitoring and the procedures for initiating corrective actions necessary to maintain training and training equipment current with program configuration and schedules will be clearly defined.

d. Reports and Schedules

A training program control schedule will be developed and maintained which will clearly portray major training milestones, critical training events and current status, and which will provide early visibility of schedule slippage or compromise and training provisioning inadequacies. Each NASA organization will submit a schedule, status and funding report to the Apollo Program Office on a quarterly basis. Reports from the contractors to the NASA organizations will be required at not less than 30 day intervals.

PERSONNEL TRAINING REQUIREMENTS ANALYSIS SUMMARY

Personnel Type, Code and Title

Number of Personnel

DATA REFERENCE	EQUIPMENT		TASK	PROFICIENCY LEVEL	PERFORMANCE CRITICALITY	TRAINING		CERTIFICATION				TRAINING EQUIPMENT		
						Orientation	Analysis	Personnel Safety	Equipment Safety	Destruct Verification	Reliability	Simulator	Operational Equipment	Training Aid
	Nomenclature	Program Element Number												
These items are extracted from the Logistics Requirements Analysis Forms						Use an X to denote requirement Training categories are listed. If no training is required, these and remaining columns will be blank.			Certification requirements are evaluated using these criteria.				Training equipment requirements will be evaluated using these categories.	

FIGURE 7.1-1; ILLUSTRATIVE SAMPLE PERSONNEL TRAINING REQUIREMENTS ANALYSIS SUMMARY

COURSE DESCRIPTION

COURSE TITLE:

COURSE NUMBER:

COURSE LENGTH: _____ **HOURS**

SECURITY CLASSIFICATION: List highest security level of information presented.

STUDENT LOAD: **Minimum** —

Maximum —

COURSE OBJECTIVE: State the desired student knowledge or skill acquisition as a result of completing this course.

COURSE SCOPE: State in brief narrative the extent of the course content.

LOCATION OF TRAINING:

METHOD OF PRESENTATION: List by percentage such elements as class lecture and discussion, equipment demonstration, training equipment utilization, student exercises, etc.

RECOMMENDED FOR: List Personnel Type Codes for which this course is recommended; also include a descriptive narrative personnel title.

COURSE PREREQUISITES: List any previous skills, or knowledge required before a person can be assigned to this course.

CONFIGURATION APPLICABILITY: This data shall reflect the system or equipment applicability of the training course. Example: SA501 and on, or SA503 through SA504, etc.

FIGURE 7.2.1-1; ILLUSTRATIVE SAMPLE COURSE DESCRIPTION

TRAINER DESIGN CRITERIA					
PROGRAM ELEMENT NOMENCLATURE AND NUMBER					
DATA REFERENCE	TASK	PERSONNEL CODE TYPE	TRAINER TYPE		DESIGN APPROACH
			Simulator	Operational Equipment	
Data from Logistics Requirements Analysis			Data from Personnel Training Requirements Analysis		Descriptive Training Equipment Item Title and Management System Number & Narrative description of required item of training equipment which integrates items appearing in other columns.

FIGURE 7.2.1-2; ILLUSTRATIVE SAMPLE TRAINER DESIGN CRITERIA

TRAINER UTILIZATION									
TRAINER NUMBER		TRAINER NOMENCLATURE (Data from Training Equipment Design Criteria)							
COURSE NUMBER	COURSE TITLE	METHOD OF UTILIZATION				COURSE LENGTH (Hours)	TRAINER USE/COURSE (Hours)	STUDENT LOAD/ COURSE	TRAINER USE (Student-Hours)
		Orientation	Demonstration	Student Practice	Certification				
Course Description Data	Course Description Data	Review total course package (objective, outline, etc.)				Course Description Data	Review total course package (objective, outline, etc.)	Course Description Data	Trainer use/ course X Student load/ course

FIGURE 7.2.1-3; ILLUSTRATIVE SAMPLE TRAINER UTILIZATION

GOVERNMENT FURNISHED TRAINING REQUIREMENTS						
TRAINING DESCRIPTION	SOURCE	PERSONNEL				JUSTIFICATION
		Code Type	Availability Date	Need Date	Quantity	
Known Course Number & Title or Brief description of objective and content.	List Contractor or NASA organization, if known	Code Number from Personnel Requirements Analysis	Schedule information from manning plans	Schedule information from Program Requirements		List why this training should be government furnished. Reference Personnel Training Requirements Analysis identification.

FIGURE 7.2.1-4; ILLUSTRATIVE SAMPLE GOVERNMENT FURNISHED TRAINING REQUIREMENTS

8.0 APOLLO PROGRAM TRANSPORTATION SYSTEM REQUIREMENTS

A comprehensive and integrated Apollo Program transportation management system is to be established and made an integral part of the logistics program at each NASA Center which requires transportation services to execute its assigned program responsibilities. This system is to encompass methods and procedures which assure the effective management and control of means used to identify, establish, integrate, acquire and apply the transportation elements necessary for satisfying the program requirements of each Center. Section 8.0 delineates the requirements, both technical and management, necessary to provide priority transportation support, as applicable, to all elements of the Apollo Program. These management systems are to be postured and applied in a manner which provides positive assurance that the Center's transportation requirements for delivery of end items, propellants, pressurants, materials and personnel are satisfied with transportation resources and services which meet program specifications and master management schedules in the most economic manner consistent with these requirements. Transportation planning will be integrated into all Apollo Program management levels.

An Apollo transportation equipment baseline will be established for all transportation equipment now defined or scoped. Any changes, modifications of existing equipment, additions and deletions contemplated or the introduction of new equipment, will be appropriately reflected in Center transportation plans.

The following factors will apply to the development of all Center transportation requirements and plans:

a. The compression of the development-to-launch cycle for Apollo Program systems into a shorter time span demands high standards of performance and system reliability of all transportation elements.

8.0 (Cont.)

b. Transportation support for the Apollo Program operational phase will be integral with that for the R&D phase, where applicable.

c. Time in-transit is of primary importance in achieving Apollo Program master management schedules and must be given full management consideration in the transportation schedules.

d. Available government and industry transportation equipment, facilities and services will be utilized to the maximum extent possible consistent with program requirements.

e. Due to urgent logistical support requirements which may exist in the critical phases of the test and launch program, a dependable and responsive spare parts airlift capability, located at selected geographic locations, will be assured.

f. Duplication in specialized transportation resources shall be avoided wherever possible. Apollo Program Centers and contractors will endeavor to integrate and utilize existing transportation, human and material resources between Centers, contractors and programs to support all phases of design, development and operations. In this connection, a lead Center concept will be further exploited.

g. Transportation staff elements in each NASA Center logistics organization are vested with the following:

(1) Providing managerial guidance and procedural policy to ensure effective, timely and responsive transportation capability in support of the Apollo Program.

(2) Development of transportation considerations for systems during the conceptual, acquisition and operational phases of the Apollo Program.

8.0 (Cont.)

(3) Preparation of transportation requirements for inclusion in the PDP's.

(4) Transportability engineering, beginning with the conceptual phase, to determine the compatibility of Apollo Program end items with existing or programed transportation capability.

(5) Preparation of detailed transportation plans for the movement of Apollo Program material.

(6) Employment of the available capabilities and programed cargo airlift to obtain maximum utilization of aircraft and landing field facilities.

(7) Ensuring that contracts include provisions for special transportation services and that such data is provided to properly evaluate procurement contracts. The Center logistics organization transportation officer or his designated representative will assist in the development and arrangement of transportation requirements pertinent to procurement and contracting.

(8) Ensuring that "transportation" is given separate treatment in program planning, management, status reporting, scheduling and control of Apollo projects.

(9) Evaluating the adequacy of utilizing existing government transportation services, equipment or facilities prior to initiating newly developed designs or contractual services for special equipment and facilities.

(10) Preparation of detailed procedure for the management, scheduling, shipment and delivery of expedited or specially controlled Apollo program material.

8.0 (Cont.)

(11) Perform trade-off studies, offering program management choices between methods of transport, during the program development phase. All factors, including performance of the mode, utilization, limitations, cost estimates, interfaces with other program elements, shall be considered in such studies.

The transportation requirements should include but not be limited to the following:

a. Identification and configuration of Apollo Program items to be transported.

b. Mode of transportation equipment to be utilized (aircraft, ships, barges and transporters, etc.) and its quantitative and scheduling requirements in accordance with the transportation requirements identified in Part II, Sections 1.0, 2.0 and 3.0.

c. Transport timed flow analysis from point of origin to destination as part of the logistics baseline, Part II, Section 1.0.

d. Design and modification of special transportation equipment.

e. Civil construction required to provide route, access or terminal transportation support.

f. Schedule of movements.

g. Budgetary requirements.

h. Packing and packaging requirements.

i. Personnel (government and contractor) to accompany item.

j. Materials handling equipment.

k. Other special consideration (i.e., environmental constraints, shock, vibration, fragility, etc.

l. Review of transportation equipment, services and facilities of other government agencies for compatibility with Apollo program requirements.

8.0 (Cont.)

Each NASA Center engaged in the execution of the Apollo Program shall ensure the development of maintenance of plans which will provide management and guidance to NASA organizations and Apollo Program contractors on all aspects of Apollo Program transportation. These plans shall include the following major areas, (8.1 Technical Requirements and 8.2 Management Requirements):

8.1 Technical Requirements - Contract End Item (CEI) detail specifications are established in the Apollo Program in response to the requirements identified in Section 1.0 of Part II and as established in the Program/Project/System/Specifications. CEI detail specifications are, in general, two part specifications. Part I is a product of the program definition phase and is the engineering instrument used to contract for design and development. Part II is a product of the design and development contract, and specifies the exact configuration information peculiar to the item. These CEI specifications are of four types as defined in the following exhibits of NPC 500-1:

a. Prime Equipment End Item - Exhibit II

b. Facility End Item - Exhibit III

c. Identification End Item - Exhibit IV

d. Requirement End Item - Exhibit V

8.1.1 With the exception of facility specs (other than the Direct Support Real Property Installed Equipment, DS-RPIE type), each of the above types of specifications are applicable to any of the following four categories of end items as defined in Exhibit XV of NPC 500-1:

a. Aerospace Vehicle Equipment (AVE)

b. Aerospace Ground Equipment (AGE) which consists of:

(1) Operating Ground Equipment (OGE)

(2) Maintenance Ground Equipment (MGE)

8.1.1 (Cont.)

c. Training Equipment (TRE)

d. Ground Instrumentation Equipment (GIE)

8.1.2 This section deals with the technical requirements to be contained in the above specification types for the various end item categories.

These requirements will be applicable to:

a. End Items of Transportation Equipment - This equipment is a type of Maintenance Ground Equipment (MGE). The management aspects of this equipment are covered in Section 8.2 of this document. Maintenance of this equipment will be as identified in Section 2.0 of Part II. All the requirements of Exhibits II, IV and V of NPC 500-1 and those included in this document are applicable to the preparation of specifications for end items of transportation equipment.

b. End Items of Transportation Facilities - The management aspects of transportation facility end items are covered in section 8.2 of this document. All the requirements of Exhibit II of NPC 500-1 and those included in this document are applicable to the preparation of specifications for end items of transportation facilities.

c. End Items to be Transported - These items will comprise, in general, all the end items of the Apollo Program system. The specific requirements with respect to transportability, preparation for shipment and delivery will be contained in all end item specifications. The applicable requirements of Exhibits II, IV and V of NPC 500-1 and this section will apply in the development of these requirements.

8.1.3 Apollo Program transportation personnel at all levels will comply with the contract end item detail specifications and will develop, assist, coordinate and/or modify the necessary

8.1.3 (Cont.)

transportation inputs to these specifications as follows:

a. Design and Performance Requirements - As described above, all the requirements of Exhibits II, IV and V are applicable to the preparation of specifications for end items of transportation equipment, as well as Exhibit III with respect to transportation facility end items. Therefore, this section is more specifically applicable to the transportation requirements as related to prime and identification of end items to be transported (Exhibits II and IV of NPC 500-1). The transportation of facility end items is considered a second order, one time function.

(1) Design and Performance - Certain contract end items directly support a project or a system. The transportation related performance and design requirements to be included in these CEI specifications shall be allocated from, identical with or be in recognition of the requirements established in the supported project or system and, if so required, program specification. These requirements shall be contained in Section 3.1 of Part I of the applicable CEI detail specification along with any other transportation related design and performance requirements that were developed as a result of additional contractually required system engineering analysis or by any other appropriate means.

(2) Transportability - The requirement of paragraph 3.1.2.5 of Exhibit II, NPC 500-1 shall be met with regard to the transportability requirements for applicable end items specifications. Transportability will be a major consideration when formulating the characteristics to be considered in the design of any new item. The possible, preferred, or specific modes of transportation

to be employed shall be specified at the time when other basic characteristics are established. Field Centers are responsible for defining design requirements and engineering programs to ensure transportability for end items. The following shall be included:

(a) Transportation modes.

(b) Special design, construction or modification to existing transportation equipment.

(c) Design and development of new special-purpose transportation equipment.

(d) Loan of special purpose equipment from other government agencies.

(e) Special design of transportation facilities such as bridges, canals, marine docks, dredging, road construction or widening, aircraft runway modifications, helicopter pads, etc.

(f) Contractual services required for special transportation assistance.

(g) Special services required from other government agencies.

(h) General route, time, equipment and transfer sequences from origin, intermediate test points and to destination (launch) - (Time-line Flow Diagrams).

(i) Peculiar or unusual tie-down requirements.

(j) Maximum "as crated" weight and dimensions.

(k) Preparation for shipment time.

8.1.3 (Cont.)

(1) Detailed preservation, packaging and packing requirements if their development and qualification is required.

The developed requirements shall be placed in Part I, paragraph 3.1.2.5 of the applicable end item specification.

(3) Induced Environment - The requirements of paragraph 3.1.2.8 of Exhibit II, NPC 500-1 shall be met with regard to transportation related induced environmental criteria for applicable end item specifications.

(4) Interfaces - The requirements of Part I, paragraph 3.2.1 of Exhibit II, NPC 500-1 shall be met with regard to interface requirements imposed on the design of CEI because of its functional, physical and procedural relationships to transportation equipment and facilities. The developed requirements shall be placed in Part I, paragraph 3.2.1 of the applicable CEI specification.

b. Preparation for Delivery - The requirements of Section 5 of Part II, Exhibit II, NPC 500-1 shall be met with regard to the preparation for delivery requirements to be included in the applicable end item specifications. These requirements will cover the areas of preservation packaging, packing and shipment and will be compatible with the specific requirements covered in Subsection 8.2.18 of this document.

c. Test - The test and verification requirements necessary to ensure compliance with the transportation related requirements to this Appendix shall be contained in Section 4 of Part I and Part II of the applicable contract end item specifications. The over-all procedural requirements applicable to this effort are contained in Exhibit II,

8.1.3 (Cont.)

Part I, Section IV and Part II, Section IV of NPC 500-1. Transportation testing will be included as a part of system test to demonstrate transportation capability via the primary and secondary modes of transportation and will encompass adequacy of specialized transport equipment and special container engineering design.

d. Other Technical Areas - Transportation and transportation related personnel within the area of their responsibility and interest shall comply with and contribute to the development of Part I and II Contract End Item Specifications Requirements in related technical areas. These areas are as follows:

(1) Reliability

(2) Maintainability

(3) Useful Life

(4) Natural Environment

(5) Human Performance

(6) Safety

(7) Design and Construction

(8) Test

The over-all procedural requirements applicable to these areas are contained in Exhibit II of NPC 500-1.

8.1.4 Support Materiel - These items are identified in their applicable higher level contract end item specifications or drawings. Of primary interest are those materiel items which are component of end items, but which are considered critical from an engineering, test and logistics point of view. Their complete technical requirements are contained in critical component detail specifications. The requirements of Exhibit VI, NPC 500-1 shall be followed in the preparation of these specifications.

8.1.4 (Cont.)

a. From the general transportation point of view the technical requirements contained in the contract end item specifications (paragraph 8.1) will be applicable to the lower level critical component specifications. However, this will not necessarily be the case with logistics critical components (i.e., multiple source items) or end items which are also items of support materiel (i.e., spares). These items will probably be handled and shipped in a different manner than their higher level assembly. The applicable specification sections will require modification to the degree necessary to reflect these differences.

8.1.5 Propellants and Pressurants - Technical information relevant to propellant and pressurants and their transportation will be developed as a part of the over-all system engineering analysis. The data developed will be included in the applicable sections of the Program/Project/System Specification (reference Section 9.0, Part II).

a. The specific transportation requirements evolving from the analysis shall be reflected for the most part in propellant and pressurant specifications which will be referenced in the Design and Construction Standards section of the Program/Project/System Specifications and the Design and Construction section of Part I of the End Item Specifications. For typical specification characteristics, see Figure 8.1.5-1.

8.1.6 Personnel - Technical requirements are not applicable.

8.2 Management Requirements - This section outlines the requirements applicable to:

a. The over-all management of the Apollo Program transportation system at all levels (NASA and contractor).

PROPELLANT / PRESSURANT	I.C.C. CLASSIFICATION	LABELING	PRIMARY/SECONDARY HAZARDS	REMARKS
Liquid Hydrogen LH_2	Flammable Gas	Red Label	Fire/explosion/low temperature	Can cause serious burns to skin; reacts violently with strong oxidizers, a serious fire and explosive hazard; hydrogen flames can be nearly invisible.
Rocket Engine Fuel RP-1	Flammable Liquid	1.Red Label 2.Placard on tank pressure.	Fire	Kerosine like hydrocarbon; handle like aviation jet fuels.
Aerozine A-50	Flammable Liquid	1.Red Label 2.Dangerous placard	Toxic/Fire	Very toxic and flammable material; vapors can be catalytically decomposed, with resulting fire or explosion. Special protective clothing mandatory for handling.
Monomethylhydrazine MMH	Flammable Liquid	1.Red Label 2.Dangerous placard	Toxic/Fire	Very toxic and flammable material; vapors can be catalytically decomposed, with resulting fire or explosion.
Liquid Oxygen LOX	Non-flammable Gas	Green Label	Fire/Low Temperature	Supports combustion vigorously; may rupture containers but does not itself burn; may form explosive mixtures with other materials.
Nitrogen Tetroxide	Poison A	Red Label, chemical NOIBN	Toxic	Very toxic fumes; highly reactive with organic materials; extremely dangerous to body tissues.

FIGURE 8.1.5-1; CHARACTERISTICS OF APOLLO PROPELLANTS PRESSURANTS RELATING TO HAZARDS IN HANDLING AND TRANSPORTATION

8.2 (Cont.)

b. The special management aspects relevant to Apollo Program transportation equipment and material.

c. The special management aspects relevant to Apollo Program transportation facilities.

d. The over-all NASA Apollo Program transportation policy.

The requirements set forth below are for the transportation of special end items, normal end items, support materiel, propellants, pressurants, and personnel. These requirements generally apply to shipments of all the above items.

8.2.1 Policy

a. Transportation will be given separate treatment in program planning, management, status reporting, scheduling and control when one or more of the following criteria apply:

(1) Total transportation cost of a contract is estimated to equal or exceed $100,000.

(2) Special transportation facilities or equipment are required.

(3) Items to be moved exceed the capabilities of commercial transportation. Development of new transportation capabilities will be resorted to only when extensive cost effectiveness studies are conducted.

b. Transportation shall be responsive to program requirements, (schedules, configuration, reliability, budgets, etc.).

c. Program managers will closely coordinate with transportation managers to effect consolidation of shipments which will minimize costs and maximize equipment utilization without undue impairment of program objectives.

8.2.1 (Cont.)

d. In the selection and development of a transportation system, strong consideration will be given to the flexibility of the selected system to meet planned future requirements with emphasis placed on standardization when practicable.

e. Transportation requirements and capabilities will be reflected in Headquarters Program Development Plans and Center Project Development Plans. Center plans will be supported by contractor transportation plans approved by cognizant Center project managers.

f. Transportability engineering will be a major consideration during the program, project developed phases of NASA programs concurrent with program planning, appropriate study, design evaluation, and procurement actions on transportation program elements will be undertaken to meet over-all program goals.

g. Maximum utilization of NASA owned and contracted transportation resources will be made. Cognizant Centers managing such resources shall make them available to other NASA Centers and government agencies on a "not to interfere" basis as long as the programs which these resources support are not impaired.

h. Resource utilization will be reviewed on a continuing basis and prompt action taken to dispose of excesses.

i. Water transportation is the acceptable mode for movement between assembly, test and launch facilities for oversize and overweight shipments except when suitable air, motor or rail services are in existence and it is determined that overriding schedule gains or cost benefits will be derived.

8.2.1 (Cont.)

j. The roll-on/roll-off concept of transfer between ship and shore and ship and barge will be employed, unless in specific cases it is not feasible.

k. Application of EDP techniques to transportation problems will be employed after studies indicate that program advantages will be derived.

8.2.2 Line Haul - Every effort will be made to utilize transportation services that are most timely, safe and economical and which meet the Apollo Program master schedule requirements.

a. Selection of Mode and Carrier - Cargo carrier selection (government and commercial) will be based on the following considerations:

(1) Transit time available to meet realistic deadline delivery dates.

(2) Physical characteristics of item to be transported and the ability of carrier to provide safe, reliable and efficient transportation service, able to meet technical minimum standards with respect to in-transit environmental control (i.e., shock, vibration, humidity, temperature, or pressure control, etc.).

(3) Security consistent with NASA policy.

(4) Lowest over-all cost, including cost of preparing shipments, handling costs, port costs related to the movement.

(5) Equitable distribution of traffic among qualified carriers.

Factors necessary to effect delivery to meet program requirements will govern. Consideration of cost and equitable traffic distribution will be regarded as secondary.

8.2.2 (Cont.)

b. Personnel - Carrier selection should provide for utilization of commercial and government air carriers, including NASA charters and NASA owned aircraft, and surface carriers, as appropriate. Carrier selection will be based on the following considerations:

(1) Availability and capability of various carriers to provide safe, reliable and efficient transportation service.

(2) Lowest over-all cost, including ground transportation costs, lost productive time costs, per diem costs, administrative costs, and all other determinable costs related to the movement.

Compliance in the selection of transportation service will be in accordance with the following NASA regulations and/or instructions:

(1) NPC 300-5, NASA Travel Regulations.

(2) NASA Management Manual Instruction 26-10-3, Subject: NASA Scheduled Airlift Service.

(3) NMI 6550.1, Subject: Acquisition and Management of NASA Controlled Aircraft.

(4) NASA Management Manual Instruction 26-10-1, Subject: NASA Administrative Aircraft.

(5) NMI 6530.1, Subject: Utilization of Headquarters Aircraft.

(6) NMI H6810.1, Subject: Requirements for Special Passenger Transportation---NASA Headquarters.

8.2.3 Routing Authority

a. Center Transportation Officers - Authority to route Apollo

Program controlled cargo will be vested in the Center transportation officer or his designated representatives. Routing authority may be delegated to contractors when qualified transportation personnel are available.

b. Contractor Transportation Personnel - Routing of traffic covered by a fixed-price contract normally is the responsibility of the contractor in accordance with the provisions of the contract.

c. Volume Shipments - With the exception of launch vehicle stages and payloads, when the total weight of a shipment moving at one time or at different times between the same origin and destination exceeds 200,000 pounds, the shipment will be referred to NASA Headquarters, Transportation and Logistics Division (BL), for possible freight negotiations in accordance with NMI 6120.1.

d. Use of GSA and MTMTS Services - Compliance with NASA Management Instruction 6040.1 is required when obtaining traffic management services from the Transportation and Communications Service, General Services Administration (GSA), and the Military Traffic Management and Terminal Service (MTMTS). Information furnished by these offices should be given full consideration in Center traffic management decisions.

e. Propellants and Pressurants - Routing authority is dependent upon the type and source of product. These authorities are as follows:

(1) Products from Commercial Sources

(a) For products purchased F.O.B. origin the provisions of Subsection 8.2.3 of this document apply.

(b) Products that are procured from commercial contractors are usually delivered F.O.B. destination.

8.2.3 (Cont.)

Routing authority is vested in the contractor at delivered price (contracts include schedule of transportation costs).

(2) Products from Air Force Stock-Fund Sources - When products are delivered at destination at a standard price, routing authority is vested in the Air Force field office having jurisdiction over the area of movement. Volume movements are routed by the Military Traffic Management and Terminal Service.

(3) Bulk Gaseous Helium - Helium is normally purchased F.O.B. origin from the Bureau of Mines and moves in government-owned rail cars or tube trailers on GBL's routed by the Bureau of Mines. In areas where the USAF acts as NASA's agent, the local routing from the distribution point to the Apollo Program user is handled by the USAF.

f. Personnel - Authority to route Apollo Program personnel will be vested only in the Center transportation officer or his designated representatives. Routing will be in accordance with Chapter 3 of NASA Travel Regulations, NPC 300-5, upon presentation of travel orders which are authorized and approved in accordance with the provisions of:

(1) Chapter 2, NASA Travel Regulations (NPC 300-5).

(2) NPD 9710.2, Subject: Authority to Authorize and Approve Travel.

8.2.4 Use of Government Controlled Transportation - Existing equipment, facilities and services of other government agencies will be employed when such will satisfy Apollo Program requirements, and when it is economically feasible to use these government resources. Contract services may be used in lieu of common

carrier services when it is necessary to insure positive control of shipments, or when common carriage cannot meet program requirements.

a. Government Owned Vehicles - Normally, government owned vehicles will be used for local drayage and emergency line-haul movements only. Commercial transportation services will be utilized when available and capable of satisfactorily meeting Apollo Program shipping requirements.

b. Contract Motor Carriage - Contract motor carriers may be used for pickup, delivery, and other local services procured through formal contracts or local purchase documents.

c. Military Air Transport Service Special Airlift - The Military Air Transport Service (MATS) will provide special airlift services to NASA on a cost reimbursable basis. Center or contractor cargo requirements for MATS special airlift will be validated by the Center and submitted to the Directorate of Transportation, Headquarters U.S. Air Force, Washington, D. C. Centers shall ensure that cargo presented for airlift is "air eligible" and carries a sufficiently high priority and otherwise meets the criteria of special air mission requirements, and that no surface means are available to satisfy the Apollo Program requirements.

d. Contract Air Cargo - When commercial air cargo service is not available or is not responsive to program requirements, Centers may contract for such support (i.e., MSFC's contract with Aero Spacelines for B-377-PG aircraft services). Contract carriers will not be used unless such service has been approved by the NASA Headquarters, Apollo Program Office, and that the provisions of NMI 6550.1 have been satisfied.

e. Military Sea Transportation Service - When commercial ocean carrier service cannot meet the Apollo Program requirements, the Military Sea Transportation Service, (MSTS) may be used provided that cargo is sponsored by a Department of Defense Agency and that satisfactory funding arrangements have been made. Sponsorship of cargo may be obtained by the Center transportation officer directly with the sponsoring service.

Exception - The NASA/MSTS Memorandum of Agreement of November 27, 1963, provides for NASA's exclusive use of two LSD type ships, the Point Barrow and Taurus for transport of Saturn launch vehicle stages. These ships are under MSFC's operational control. Centers requiring ocean lift services in these special purpose ships will levy their requirements on MSFC (Code I-PL-T, Tel.: 877-2593).

f. B-377-PG (Pregnant Guppy) - In addition to MATS and DoD air charter capabilities, outsize cargo may be moved by a modified Boeing B-377 aircraft under contract to MSFC. This aircraft is under MSFC's operational control. Centers requiring airlift services in this special purpose aircraft will levy their requirements on MSFC (Code I-PL-T, Tel.: 877-2593).

g. U.S. Army CH-47A (Chinook) Helicopter - The NASA/Army Memorandum of Agreement of June, 1965, provides the capability of a CH-47A Chinook (heavy lift cargo helicopter) for air transport of outsize Apollo cargo too large for MATS or the B-377-PG aircraft. Centers requiring the use of this helicopter will levy their requirements on MSC (Code PG-8, Tel.: 483-5393).

8.2.5 Private Motor Carriage - Privately owned vehicles of Apollo Program contractors may be used for pickup, delivery or line haul services without restriction provided that cost and service disadvantages are not incurred.

8.2.6 Premium Transportation - Delivery requirements usually determine when the use of premium transportation should be considered. The use of premium transportation should be based on time, distance, cost and service. Short line hauls are usually more expeditious via motor service than premium transportation service. However, security protection requirements may prevent the use of a lower cost transportation. The Center transportation officer will assist project managers in final determination of the most advantageous transportation service to be utilized.

8.2.7 Routes - Movement shall be planned via routes that are safe, reliable and contribute to minimizing transit time. Shipment planning will make provision for an alternate mode and route as backup and a system's test in the event that the primary mode and route selected cannot be implemented.

a. Personnel:

(1) Commercial - The bulk of personnel travel is performed via commercial carriers. Route requirements are normally satisfied by the carrier in his manner of conducting business and in complying with the regulatory requirements imposed on the carrier in his operating authority and certificate of public convenience and necessity.

(2) Government - Travel via government means consists of air travel via NASA Administrative Aircraft, NASA scheduled airlift service, or DoD airlift services (e.g., MATS, special flights, etc.).

NASA Administrative Aircraft and Chartered Flights - Comply with the applicable provisions of subsection 8.2.7d and NMI 26-10-1.

b. Marine Routes - Marine planning and operations shall be reflected in Center transportation plans to ensure that:

(1) Adequate facilities are designed, constructed, tested and available to meet scheduled movement requirements.

(2) Compatible interfaces exist between facilities, transportation equipment, loading equipment and the cargo.

(3) Adequate water depth in rivers, waterways, turning basins and harbors.

(4) Adequate horizontal and vertical clearances of bridges, locks, canals, channels and overhead cables.

(5) Proper navigational aids are installed in NASA owned marine facilities.

(6) Availability of proper dock facilities with adequate mooring devices, lighting, power, water, etc.

(7) Compliance with regulatory construction requirements of the U.S. Coast Guard and American Bureau of Shipping for marine equipment and with I.C.C. regarding operating rights and authorities.

(8) Qualification and licensing of operating personnel.

(9) Weather Bureau assistance, particularly for movements during hurricane season.

(10) U.S. Coast Guard escort and surveillance services.

(11) Logistic support at marine terminals, i.e., fuel provisions, voyage repairs, water, stores, etc.

(12) Dock priorities are assigned to insure prompt turnaround times.

(13) Route and facility maintenance.

c. Land Routes - Rail and truck movement planning shall be reflected in Center transportation plans to insure:

(1) Compliance with NMI 6340 for shipment of oversize and overweight cargo.

(2) Route clearance authority and special highway permits for outsize cargo are obtained (NMI 6340).

(3) Adequate facilities are provided to meet scheduled movement requirements.

(4) Compatible interfaces exist between facilities, transportation equipment, loading equipment and the cargo.

(5) Availability of specialized surface equipment such as transporters, tractors, supporting environmental control equipment required for the safe transport of Apollo cargoes.

(6) Adequate horizontal and vertical clearances of overhead wires, overpasses, bridges, trees, road widths and adequate road and bridge load bearing requirements.

(7) Compliance with ICC and cognizant state transportation regulatory authorities' regulations in the design and construction of NASA owned or leased surface transportation equipment.

(8) Qualification of operating personnel.

(9) Availability of local and state law enforcement personnel for escort and surveillance services.

(10) Route and facility maintenance.

(11) That special ICC permits are obtained, as required, for movement of cryogenic products such as liquid hydrogen.

8.2.7 (Cont.)

d. Air Routes - Air movement planning shall be reflected in Center transportation plans to ensure that:

(1) Arrangements are made through joint agreement for use of military or commercial airfields to support and meet scheduled movement requirements. Permission for NASA leased or commercial contract flights to land at military air bases will be obtained by contacting the following commands:

Air Force - Headquarters, USAF
Directorate of Aerospace Programs (AFOAPDA)
Washington, D.C. 20330

Army - Assistant Chief of Staff for Force Development, Department of the Army
Washington, D.C.

Navy - Chief of Naval Operations
Department of the Navy
Washington, D.C.

(2) Adequate specialized air cargo lift trailers, pallets, transporters and handling equipment to meet scheduled movement and delivery requirements.

(3) Compatible interfaces between facilities, aircraft, loading equipment and the cargo.

(4) Planned flights utilize airports with sufficient runway lengths and load bearing surfaces for safe take-off and landing with Apollo Program payloads. Information on airport facilities is contained in the USAF/USN Flight Information Publication, entitled, "Enroute-Supplement United States."

(5) FAA requirements and standards for the safety, design, certification and operating requirements and standards of NASA owned or leased aircraft is complied with.

8.2.7 (Cont.)

(6) Qualification and licensing, as necessary, of flight and ground support personnel.

(7) Adequate road clearances leading to and from airports exist as outlined in subsection 8.2.7c.

(8) Flight planning place heavy emphasis on weater evaluation to ensure that Apollo Program cargoes are not subjected to flight conditions that might prove injurious to these cargoes.

(9) Personnel accompany shipments when cargoes require technical monitoring in-flight as well as on the ground.

(10) Arrangements are made for logistic support (fuel, lubricants, flight line maintenance, etc.) of NASA owned or leased aircraft. Fueling of aircraft at Air Force Bases will be in accordance with NASA Management Instruction 28-6-1. Fuel at government prices is also available at other government facilities and should be utilized. Procurement of government priced fuel at commercial airports for NASA owned aircraft will be in accordance with NASA TWX 121445Z of August, 1964.

(11) FAA requirements and specifications are complied with in the design of propellant and pressurant containers which are air transported.

(12) Route and facilities maintenance is initiated.

8.2.8 Transportation of Explosives and Other Dangerous Articles - Transportation officers will strictly comply with NASA Management Instruction 28-5-2 when shipping explosives or other dangerous articles.

8.2.9 Security - Shipments which are of a classified nature will be handled in accordance with the provisions of paragraphs 6 and 12 of the Department of Defense Industrial Security Manual for

8.2.9 (Cont.)

Safeguarding Classified Information, NMI 24-1-1 of 24-3-1 and Apollo Program Security Classification Guide SC9-11.

8.2.10 Equipment Selection - In selecting transportation equipment the following conditions will be satisfied by the basic equipment employed:

a. Permits safe physical handling of the item on, off and in the transportation equipment.

b. Satisfied environmental, shock, vibration and security requirements specified by the Project Manager which will maintain CEI reliability and quality assurance upon delivery.

c. Ensures full compatibility with facility and handling interfaces.

d. Provide safe, economical transportation of propellants and pressurants including cyrogenic materials.

When suitable equipment and services are not available from commercial sources, attempts will be made to utilize government controlled equipment and services as described in Subsection 8.2.4. If existing government equipment is selected and subsequently modified, the requirements of paragraph a, Subsection 8.1.2 of this document will be satisfied in preparing performance specifications for end items of transportation equipment. The above reference will also apply when procuring new construction end items of transportation equipment.

8.2.11 Definition of Shipping Requirement - In order that optimum transportation service at the least possible cost can be attained by transportation personnel, shipment sponsors shall supply transportation personnel with a complete nomenclature of the item to be shipped.

8.2.12 Freight Classification - The proper freight description of material shipped is the basis for which transportation rates are assured. The importance of assigning proper freight classification cannot be over-emphasized. The following guides will be used to provide proper freight descriptions:

a. Descriptions - Use specific classification from the applicable Uniform Freight Classification (UFC) or National Motor Freight Classification (NMFC). General terms such as "stores," "radio equipment," etc., should never be used.

b. Use of "NOI" - Avoid "NOI" descriptions (not otherwise indexed) when possible. When NOI descriptions are used, the technical description shall be shown in parenthesis immediately following the freight classification description on the bill of lading.

c. Classification Guides - Utilize, as necessary, the MTMTS and GSA freight classification guides to convert the technical description of an item to the proper freight classification description.

d. Assistance - Seek assistance from carriers, weighing and inspection bureaus, or other competent authority when a freight classification description cannot be precisely determined from the published Freight Classifications or MTMTS/GSA Freight Classification Guides.

e. Problems - Refer classification problems that cannot be resolved at the field level, as well as any prescribed freight classification which appears unreasonable, to NASA Headquarters (BL). Advice should be advanced as to description, type of material, trade name and value. NASA Headquarters (BL) will negotiate with the cognizant classification authorities to resolve the problem.

8.2.12 (Cont.)

f. Dangerous Materials Descriptions - Use the description shown in ICC regulations when shipping explosives or other dangerous materials. If the description of the article as prescribed by carrier's traffic is different, it will be shown in parenthesis immediately after the Campbell's Tariff #10 description (ICC Regulations).

8.2.13 Insurance and Valuation of Shipment

a. Insuring Shipments - In compliance with the policy of the United States Government, shipments will not be insured against loss or damage, except as specifically authorized by the Secretary of the Treasury under the provisions of the Act of July 8, 1937 (50 Stat. 479; 5 USC lw 134) covering shipment of "valuables," as defined in the Act and by the Secretary of the Treasury pursuant thereto.

b. Released Valuation - When carriers quote different rates based on different values to be declared by shippers for particular shipments, property will be released at the maximum valuation applicable to the lowest published transportation charges, and the bill of lading will be so annotated.

c. Actual Valuation - When carrier's tariffs require actual value be stated, the true value rather than the lowest released values will be shown.

8.2.14 Consolidation of Shipments - Consolidated shipments generally result in lower transportation costs, improved service and reduced administrative expenses. To obtain these advantages, the following actions shall be taken:

a. Consolidate all shipments from one consigner to one consignee on a daily basis and ship on one bill of lading.

8.2.14 (Cont.)

b. Hold low priority or routine shipments up to five working days, or longer if necessary, when there is a reasonable expectancy of accumulating a carload or truckload shipment (including stop-off or split shipments) without jeopardizing the required delivery date at destination.

8.2.15 Documentation - Documentation will be prepared as required to meet regulatory requirements and to the degree necessary to ensure that shipments are moved on a controlled, timely and economical basis. Government bills of lading will include equal opportunity provisions as required in NASA Circular No. 298.

8.2.16 Exclusive Use of Vehicle - "Exclusive use of vehicle" service is premium transportation. Because of the higher transportation charges that result from this service, actions will be taken to apply stringent controls in the use of exclusive use of vehicles.

8.2.17 Mail and Parcel Post Service - The U.S. Postal Service provides a safe, economical and expedited service of transporting small shipments, particularly those weighing under 25 pounds. Parcel post service should be used whenever possible unless tracing, special handling is required or the delivery requirements prohibit use of this method.

8.2.18 Expediting and Tracing - To facilitate meeting required delivery dates and locating shipments which have not been delivered within a reasonable time, the following action will be taken when necessary and appropriate:

a. Expediting Action - Request originating carrier to provide expediting service when material is urgently needed at destination or if material may be otherwise delayed because of congestion over the route of movement.

8.2.18 (Cont.)

b. Tracing Action - Request carrier furnish location and passing reports if material has not been delivered within a reasonable time after it has been tendered for transportation. Tracing and expediting action of this nature may be levied by either the consignor or the consignee.

8.2.19 Reconsignment and Diversion - In effecting reconsignments and diversions of carload and truckload shipments, the following actions shall be taken:

a. Confirmation - Confirm requests in writing to any of the carriers participating in the through movement.

b. Shipping Documents - Ensure that the bill of lading is amended to reflect changes.

c. Notice - Notify all parties concerned.

8.2.20 Transit Privileges - Significant cost savings can be achieved by taking advantage of transit privileges on carload and truckload shipments when such services are offered by carriers' tariffs or Section 22 tenders. Where recurring volume movements are received in-bound and subsequently shipped out-bound in volume lots, the following action shall be taken at intermediate points:

a. Exercise existing transit privileges, when available.

b. Initiate steps with carriers to grant privileges where traffic volumes merit such treatment.

c. Refer to NASA Headquarters (BL) any transit privilege possibilities, so that NASA Headquarters can negotiate with cognizant traffic authorities for possible transit privileges.

8.2.21 Export and Import Traffic - There is relatively little export and import traffic that is handled directly by transportation

8.2.21 (Cont.)

officers in the Apollo Program transportation system structure. Transportation requirements supporting the worldwide Apollo Program Ground Operational Support System (GOSS) are normally handled directly by the NASA Office of Tracking and Data Acquisition through the Goddard Space Flight Center.

8.2.22 Loss and Damage - In order to restrict loss and damage of Apollo materiel to the barest minimum, an effective loss and damage program will be conducted to:

a. Minimize loss and damage in transit.

b. Establish liability for losses and damages which occur.

c. Expedite successful claim action.

d. Determine contributory causes of loss and damage.

e. Initiate action to correct deficiencies.

8.2.23 Negotiations by NASA Headquarters - Any proposals for negotiations with carriers for reasonable and equitable rates, charges and services will be forwarded to NASA Headquarters (BL) for review and consideration. These proposals may be submitted with the report of volume movement required by paragraph c of Subsection 8.2.3.

8.2.24 Procurement Traffic Management - The efficient application of traffic management principles outlined in Part I, Subpart 13, Terms Procurement Regulations during the procurement process will materially improve the efficiency of Apollo Program procurement and substantially lower the costs of shipping newly procured items. Accordingly, transportation officers will assist procurement officers in the procurement process as indicated below:

a. Delivery Terms - Advise procurement officers as to the most advantageous delivery terms to be incorporated in contracts.

b. Commodity Descriptions - Furnish procurement officers with clear and complete commodity descriptions in order that correct freight transportation charges may be determined.

c. Bills of Lading - F.O.B. origin purchases will be shipped on GBL's furnished to the contractor, or on commercial bills of lading to be converted to GBL's at destination.

d. Routing - Comply with provisions of Subsection 8.2.3. Property shipped F.O.B. origin normally will be routed by NASA transportation officers, but the routing authority may be delegated to the contractor. Property shipped F.O.B. destination normally will be routed by the contractor, but for valid and compelling reasons, Center transportation officers may direct use of a specific mode or carrier.

e. Items of Unusual Size, Weight or Shipping Characteristics - When evaluating contract awards for items requiring special handling or special transportation equipment, the following factors should be given careful consideration:

(1) Limitation of Transportation Modes - The unusual characteristics of some articles preclude the use of certain transportation media. For example, many launch vehicles cannot be moved over line haul distances by air, rail or highway.

(2) Transportation Costs - Often the line haul costs of transporting outsize cargo will be small compared to the rigging, crane service and other handling services at origin, destination and at intermediate points. Therefore, over-all landed costs rather than line haul transportation costs should be a prime consideration in bid evaluations.

8.2.24 (Cont.)

(3) Shipper's Facilities - The shipping facilities and specific location of one bidder's plant may result in greater or lesser over-all transportation costs than would accrue on a shipment from a competitor's plant.

8.2.25 Safety in Shipping and Handling Propellants and Pressurants - Pressurants are totally inert chemicals. Liquid propellant fuels and oxidizers are, in general, highly reactive chemicals. Consequently, the pressurants and propellants and their reaction products possess certain hazardous properties which must be fully understood by all who are required to transport and handle them. Further, in the case of cryogenics, their extreme low temperature is an additional hazard. Figure 8-1 depicts hazard characteristics related to transportation and handling. In order to prevent accidents which may cause loss of life, serious personal injury, equipment and facilities damage, and program delays, a propellant and pressurant safety program will be conducted which recognizes all aspects of Figure 8-1. In addition, this program shall include, but is not to be limited to, the following:

a. Personnel training, supervision and health.

b. Lightning protection systems.

c. Static electricity protection systems and procedures.

d. Procedures to combat hazards of fire, explosion and toxicity.

e. Issuance of safety instructions and regulations.

f. Storage and handling procedures.

g. Compliance with the following NASA Management Instructions:

(1) NMI 23-1-2, NASA Safety Guide

8.2.25 (Cont.)

(2) NMI 1720.1, Explosives Safety Surveys by Armed Services Explosives Safety Board.

(3) NMI 1730.1, Policy on Purchase and Issue of Protective Clothing and Equipment.

(4) NMI 1711.1, Reporting, Investigation and Action on Accidents Involving NASA Employees, Resources, or Property.

The elements of an effective safety program are contained in the DoD publication entitled, "The Handling and Storage of Liquid Propellants," dated January, 1963 and issued by the Office of the Director of Defense Research and Engineering.

8.2.26 Contractor Personnel Travel - Policies shall be established which will ensure that:

a. Contractor personnel travel in connection with support of the Apollo Program is valid and necessary.

b. Contracts are reviewed to insure that expenditures are within reasonable limits and that travel performed was necessary to meet program requirements.

c. Necessary corrective action is initiated to eliminate travel abuses.

8.2.27 Use of Contractor Owned Vehicles - Comply with paragraph 5367 of NPC 300-5, NASA Travel Regulations.

8.2.28 Preparation for Shipment - Preparation for shipment must satisfy requirements that will protect Apollo Program end items and support materiel against physical damage, loss deterioration, corrosion, degradation and substitution while in transit or in storage awaiting transportation or delivery. The requirements for cleaning, drying, preserving, packaging, packing, marking and inspection should be stringent enough

8.2.28 (Cont.)

to deliver end items in a safe and reliable condition within the required time frames and at the most economical cost.

a. Technical Requirements - Specific cleaning, drying, preservation, packaging, packing, marking and inspection requirements for special and normal end items will be contained in the applicable CEI specification.

b. Guidance - Comply with the provisions of:

(1) NASA Quality Publication NPC 200-1A, paragraphs 3.12 and 3.8.

(2) NASA Quality Publication NPC 200-2, paragraphs 11.2, 11.6 and 5.6.

(3) NASA Quality Publication NPC 200-3, paragraphs 3.11, 4.12.2 and 4.13.

(4) Apollo Reliability and Quality Assurance Program Plan NHB 5300.1, Section 4.17.

(5) NASA Procurement Regulation, NPC 400, Part 14.

c. Materials - Materials shall be selected that will economically and efficiently provide the required protection. Material specifications will be developed for materials not specifically covered by existing federal, military or industrial specifications. Certification or quality tests will be required to assure conformance with applicable specifications.

d. Regulations - Packaging, packing and marking will be in accordance with commercial tariff and freight classification requirements and with the regulations of other government agencies, when applicable. Full compliance with regulations is mandatory when preparing dangerous articles for shipment.

8.2.28.1 Preservation

a. Applicable Specifications - Military Specifications MIL-P-116D and MIL-STD-726A.

b. Selection Criteria - The preservation process used shall be the minimum that will afford adequate protection during normal handling, transit and storage. Selection of a process shall be predicated on the following criteria:

(1) Characteristics of the item.

(2) Designated mode of transportation.

(3) Destination storage conditions.

(4) Anticipated length of storage.

c. Dessicants - Dessicants may be utilized on an "as needed" basis to afford supplemental protection against water-vapor damage. If a dessicant is used, it will conform to Military Specification MIL-D-3464.

8.2.28.2 Packaging

a. Applicable Specifications - Military Specifications MIL-P-7936C and MIL-STD-726A.

b. Selection Criteria - Packaging requirements and levels of packaging shall protect items from shock, vibration, abrasion, contamination, corrosion and other damaging elements during the transportation phase. Selection of packaging shall be predicated on the following criteria:

(1) Characteristics of the item.

(2) Designated mode of transportation.

(3) Destination storage conditions.

(4) Anticipated length of storage.

8.2.28.2 (Cont.)

For items subject to deterioration or damage that will affect the reliability of the system, the field Center shall require contractors to provide packaging, handling and transport instructions as a part of the procurement document. Levels of preservation and packaging shall be continually monitored to be compatible with the transportation mode.

c. Cushioning - Shock absorbing materials will be used when required to afford protection to items from physical damage during handling, shipment and storage. Materials used shall be tested to assure conformance with applicable design criteria.

d. Covers - Flexible waterproof environmental covers will be used, as required, on special end items to protect surfaces from abrasion and prevent the entrance of water, sand, dust and other contaminants. When transported by modes other than air, a heavy duty flexible transport cover may be used to provide additional protection against in-transit hazards and maintain the cleanliness of the environmental cover.

e. Re-use of Materials - When determining the packaging method to be utilized, a concentrated effort will be made to reuse materials and containers in which vendor supplied items are shipped.

f. Disassembly and Reassembly - When savings in packaging and transportation costs are to be accomplished by disassembly of items, such assembly (and reassembly) must be capable of accomplishment with ordinary hand tools. All nuts, bolts, screws and assembly hardware must be placed in bags and identified and packed with the item. Assembly instructions sufficiently detailed for easy reassembly must accompany the package.

8.2.28.2 (Cont.)

g. Kits - Installation and modification kits shall be cleaned, preserved and packaged so as to facilitate use at destination. Components of kits shall be identified on the package as to item numbers, part number and nomenclature appearing on the installation or modification instruction.

h. Matchmarking - Disassembled parts which are not interchangeable shall be matchmarked to facilitate reassembly. Matchmarking shall be accomplished by means of tags with suitable identification printed thereon. Where possible, within size and weight limitations of the containers, matched parts shall be packaged in the same container.

i. Packaging Data - Packaging data shall be prepared for each individual item to be shipped under the contract or order. Packaging data shall completely describe the package and material to be used.

(1) Packaging Instructions - Packaging instructions will contain all the information required to facilitate the package. Packaging instructions will contain all special marking information and any precautionary remarks to facilitate special handling or protection required. The packaging instructions will indicate details required for the fabrication of special containers, cushioning, blocking or bracing.

(2) Packaging Drawings - Packaging drawings will be made on reproducible masters in accordance with current contractors' government approved drafting practices.

8.2.28.3 Packing

a. Applicable Specifications - Military Specifications MIL-P-7936C and MIL-STD-726A.

8.2.28.3 (Cont.)

b. Container Design - Containers will be compatible with on-site and transportation handling, storage, storage methods and facilities. Provisions will be incorporated, where applicable, for crane hoist, fork lift, and tie down.

c. Openings - Access doors of special end items will be secured to restrict their movement during transit and all fittings will be capped or plugged and covered with a plastic bag.

d. Environmental Protection - Where applicable and appropriate, and to prevent system degradation, special end items will be shipped with environmental and reaction control systems pressurized with suitable dry pressurant gases.

e. Rigid Covers - In addition to shrouds and covers, a heavy duty rigid transport cover will be provided, as required, for special end items as protection against in-transit hazards. Dust proof attachments will be provided for securing the rigid cover. Lifting rings for hoisting the cover will be incorporated into its design.

f. Overpack Exceptions - Unit and/or intermediate containers meeting the requirements of UFC Rules 40 and 41, or NMFC Rule 5, do not require additional overpacking.

g. Unpacked Items - Items sturdy enough to withstand shock insured during handling and movement by the designated mode of transportation shall be shipped devoid of packing. Carrier capabilities and limitations will be considered as the basic criterion for placing an item in this category.

h. Wheeled Items - Wheeled items shall be shipped uncrated as mobile packs, when feasible.

8.2.28.4 Marking

a. Applicable Specifications - Military Specification MIL-STD-129C.

b. Precautionary Marking - In marking dangerous articles comply with the provisions of the following instructions and regulations, as applicable:

(1) NASA Management Instruction 28-5-2.

(2) CFR 49, parts 71-78: Code of Federal Regulations.

(3) AFM 71-4, Packaging and Handling of Dangerous Materials for Transportation by Military Aircraft.

(4) ICC Tariff 15: Regulations for Transportation of Explosives and other Dangerous Materials by Land and Water.

(5) ICC Tariff 6C: Governing the Transportation of Restricted Articles by Air.

(6) TM 38-250: Packaging and Handling of Dangerous Materials for Transportation by Military Aircraft.

(7) NavWep 15-03-500: Packaging and Handling of Dangerous Materials for Transportation by Military Aircraft.

(8) MCO-P-4030-19: Marine Corps Operation.

c. Reusable Containers - Reusable containers shall be marked, "REUSABLE CONTAINER - DO NOT DESTROY."

d. Special Marking - Special marking showing the effectivity of the parts in the container will be shown on each package.

e. Life Limits - Markings will also identify the items which have a life limit and those which must be recalibrated on a periodic basis.

8.2.28.5 Inspections

a. Shipping Inspection - When shipping Apollo Program items ensure that:

(1) Items are complete and all required fabrication, tests and inspections have been performed.

(2) Items and accompanying documents are properly identified as to inspection status with NASA Quality Status stamps in accordance with paragraph 3.2 of NPC 200-1A.

(3) Required shipping and technical documentations, including approved waivers and deviations, have been provided.

(4) Items are in the proper state of assembly, and have been preserved, packaged, packed and marked in accordance with applicable specifications and procedures.

(5) Handling devices and transportation vehicles are suitable for the items involved and are loaded in such a manner so as to prevent damage.

(6) Loading and transportation methods conform to applicable specifications and regulatory requirements.

b. Reinspection - In the event of any authorized or unauthorized removal of an article from its container, the extent of reinspection and retest shall be as authorized by the cognizant NASA installation or its authorized representative.

c. Receiving Inspection - In connection with all items received, consignees review in depth to determine:

(1) That quality of the item has not been degraded.

(2) Whether items were damaged in transit and if the results of previous inspections should be voided due to preparation for shipment and handling operations.

8.2.28.5 (Cont.)

(3) What corrective action is required to correct deficiencies and to preclude reoccurrence of damage and quality degradation in transit. Corrective action should be initiated in a timely manner, as required.

8.2.28.6 Handling - The handling of end items encompasses intra-plant movements in the manufacturing and test, loading, and delivery phases of the transportation cycle. Handling must satisfy requirements that will protect end items against physical damage, deterioration, corrosion and degradation while they are being moved within plant or test sites, loaded into transportation equipment and when delivered to consignees.

The requirements for handling Apollo Program materiel are generally the same as those for end items. However, the bulk of items in the materiel category do not require some of the specialized techniques required for handling outsized and delicate special end items but are handled in accordance with common commercial warehousing practice.

a. Disassembly and Reassembly

(1) Unnecessary handling - In order to eliminate unnecessary assembly and disassembly steps, which may prove costly, measures shall be taken to ensure that appurtenances are not attached to end items in the manufacturing phase which must be later removed for packing and shipping, provided that full assembly is not required for test, alignment, etc.

(2) Packaging and Transportation Savings - Comply with the applicable provisions of Subsection 8.2.28.2f of this document.

b. Cover/Uncover and Environmental Protection

(1) Covers - The provisions of Subsection 8.2.28.2d and 8.2.28.3e of this document apply.

(2) Instrumentation - Instrumentation monitoring with characteristics, temperature and/or humidity control shall be installed and utilized as required.

(3) Dessicants

(a) Dessicant charges shall be installed as necessary to dehydrate enclosed air.

(b) When used in an air transportation system, dessicant containers shall be removed from breather installations on components prior to loading in an aircraft. They shall be reinstalled after the components have been unloaded from an aircraft.

(c) The provisions of Subsection 8.2.28.1c of this document also apply.

(4) Pressurization - Shipping containers, fuel tanks, oxidizer tanks, etc. shall be pressurized as necessary, with suitable dry gases so as to maintain component reliability and prevent system degradation.

c. Intra-Plant Movement

(1) Special Handling - Comply with provisions of paragraph 11.4 of NASA Quality Publication NPC 200-2 which requires that special handling will be required for items which are susceptible to handling damage. All installation and test sites shall be provided copies of special handling instructions to ensure safe and adequate handling.

(2) Special Equipment - Ensure that specialized equipment such as transporters, dollies, support rings, special slings, skids, covers, carts, boxes, containers and transportation vehicles are available and utilized as necessary to prevent damage, and to maintain reliability of end items.

8.2.28.6 (Cont.)

(3) Handling Characteristics - Plans, manuals, handling instructions, etc., shall clearly indicate dimensions, weight and other pertinent data of end items and components so as to facilitate handling equipment design and handling procedures.

(4) Data Sheets - Data sheets shall be prepared for each type of specially designed handling equipment which should include but are not limited to the following:

(a) Descriptive information (description, stock number if available, weight, dimensions, capacity, manufacturer).

(b) Inspection information.

(c) Cleaning information.

(d) Lubrication information.

(e) Trouble analysis information.

(f) Maintenance information

(g) Packaging, packing, storage and transportation data.

(5) Towing Speeds - Establish and enforce safe towing speeds for equipment used in the manufacturing, test, loading and delivery areas.

8.2.28.7 Loading and Unloading

a. Supervision - A loading supervisor shall be designated for all loading and unloading operations. He shall have sole approval authority for all loads and will ensure that safe practices are used throughout the loading and unloading process to prevent damage to the cargo and equipment and injury to personnel.

b. Services - Operations shall be planned to ensure that adequate supporting equipment, qualified personnel and support services are available to perform loading and unloading tasks in a safe and reliable manner.

c. Procedures - Loading and unloading operations shall be performed in accordance with well defined and published technical orders, manuals or procedures, which clearly set forth procedures, responsibilities, etc. Apollo Program personnel will comply with Air Force, Army and Navy technical orders and manuals when DoD transportation equipment is used in line haul service.

d. Safety - Personnel not involved in loading and unloading operations shall not be permitted in the area where these tasks are performed. Wherever known hazards exist, warnings in the form of lights, signs, flags or barriers must be used to keep out unauthorized personnel. Compliance with the following NASA Management Instructions is mandatory:

(1) NMI 23-1-2: NASA Safety Guide

(2) NMI 1711.1: Reporting, Investigation and Action on accidents involving NASA Employees, Resources or Property.

e. Hoisting - When hoisting end items, procedures will ensure that hoisting devices are designed and used in a manner to avoid damage, chafing and causing undue stress on component parts. Safe working load limits of slings and hoisting equipment shall not be exceeded.

f. Aircraft Loading and Unloading

(1) Placement of loads in aircraft must establish the center of gravity of the aircraft within allowable

limits. The aircraft loadmaster is responsible in determining the center of gravity of the aircraft. Thus, all loads must be installed in the loading sequence as directed by the loadmaster. The loadmaster has final approval authority on placement and securing of loads. Effective measures will be taken to insure that aircraft are not overloaded and/or center of gravity limits exceeded. Actual weights shall be verified and agree with manifested weights to preclude dangerous overloading conditions.

(2) Effective measures will be taken to prevent damage to the B-377-PG (Pregnant Guppy) aircraft during loading and unloading operations. This aircraft is especially vulnerable when the fuselage is separated; therefore, an aircraft and tail section handling plan shall be developed and implemented which will include:

(a) Aircraft tie-down procedures with specifications for construction and spacing of aircraft tie-down anchors and method of securing tie-down cabling.

(b) Ground handling procedures.

(c) Material handling equipment requirements.

(d) Personnel requirements.

(e) Operational checklist.

g. Rail Car Loading - Rail cars shall be loaded, blocked and braced in accordance with American Association of Railroad car loading rules.

8.2.28.7 (Cont.)

h. Demurrage - Rail cars will be promptly loaded and unloaded and cars released so that demurrage costs will not be incurred. If operating on a straight demurrage agreement, efforts will be made to release cars within the established free time. If operating on an average demurrage agreement, efforts will be made to release cars within the established free time in order to earn credits to offset debits. Car records will be maintained at each activity. These records shall be used to certify demurrage bills and to determine if carrier's equipment is promptly released. The same loading principles of prompt release of equipment apply to truck and ship operations to preclude incurring equipment detention charges.

i. Weighing - Generally, the actual weight of cargo will be determined by the shipper by weighing all or part of the shipment. If the weight cannot be determined by the shipper, the carrier will be instructed to weigh the cargo. Cargo need not be weighed if a reliable weight can be obtained from inbound shipping documents or if cargo is covered by weight agreements with the carrier or by tariff weights shown in the carrier tariffs or classifications.

j. Seals - Seals shall be applied to carrier's equipment for carload and truckload shipments. Seal numbers will be recorded on the bill of lading. Broken or missing seals will be reported by the consignee to the consignor.

8.2.28.8 Blocking/Bracing and Tie-Down

a. Ensure that adequate blocking, bracing and tie-downs are applied to the lading so as to restrict its movement while in transit and prevent damage to the lading and the transportation equipment.

8.2.28.8 (Cont.)

b. Ensure that tie-down chains and cables are attached in such a manner that they will not effect damage to the end item or its component parts.

c. Ensure that the angle of tie-down chains and cable is proper to conform to the gravitational force requirements of the tie-down plan.

d. Comply with the provisions of Subsection 8.2.28.7 of this document.

8.2.28.9 Depackaging and Depreserving - Upon delivery to the ultimate consignee, ensure that safe and adequate depackaging and de-preservation procedures are utilized which will preclude damage to end items when removing shipping covers, packaging, preservation and shipping instrumentation.

a. Inspection - Comply with the provisions of Subsection 8.2.28.5.

9.0 APOLLO PROGRAM PROPELLANTS AND PRESSURANTS REQUIREMENTS

A comprehensive and integrated Apollo Program propellants and pressurants (p & p) management system is to be developed and established and made an integral part of the logistics program at each NASA Center requiring these products to discharge its assigned program responsibilities. This system is to provide methods and procedures which assure the effective management and control of the means used to identify, integrate, acquire and apply the Center's propellants and pressurants for all its program needs (i.e., research and development, test, operations, etc.). These management systems are to be postured and applied in a manner which provides positive assurance that the Center's p & p requirements are satisfied with products and facilities which meet needed quality and capability standards and program need dates in the most economic manner consistent with these requirements. The subsequent portions of Section 9.0 describe these management systems requirements in further detail.

9.1 Inter-Center Propellants and Pressurants Requirements Integration

Effective and efficient methods are to be developed and established within each Center's p & p management system for assuring that the respective Center p & p requirements are coordinated and integrated with those of other program Centers.

9.2 Forecasting and Consumption Reporting

Timely and accurate forecasts of each Center's Apollo Program propellants and pressurants requirements are to be provided by the Center's program logistics function. As a minimum, forecasts delineated in paragraph 52.500 of NPC 400 and such other forecast information required by the regional propellant support agency shall be satisfied by each Center. NASA Form 558 shall be used (unless otherwise specified herein) in responding to these forecast requests.

794-693 O-65-18

9.2.1 Forecast Responsibilities

Forecasting information shall be accomplished by the NASA laboratory or test facility, Apollo Program contractor or subcontractor and integrated by each Center's program logistics function. The appropriate Center Apollo Program office shall review and validate supplied forecasts. These forecasts shall be compiled on the basis of program end item, system, and major component p & p requirements and their required geographic location. The Center's program logistics function shall integrate these requirements and compile and publish its total Apollo Program p & p requirements forecast on a Center basis.

9.2.2 Forecast Basis

Forecasts shall be based on programed Apollo program activity. Forecast originators shall develop and use systematic methods of computing their cognizant p & p requirements. The Center Apollo Program logistics organization charged with its Center's over-all p & p forecasting responsibility shall provide guidance, review and approve methods developed by the Center's various forecast originators. Forecast computations shall be in consonance with the logistics baseline and maintenance requirements analyses data and shall be based on the number of test seconds, quantity required per test second, losses per test second, fixed losses per individual test, propellant receiving, storage and transfer losses, program contingencies, and other factors influencing propellant consumption. The provided forecasts shall be postured, timed and utilized in a manner which prevents propellant shortage or uneconomical propellant supply practices.

9.2.3 Consumption Reporting

Comprehensive and accurate propellant and pressurant consumption reports shall be provided by each Center's Apollo Program

9.2.3 (Cont.)

logistics function. These consumption reports shall include all their Center's in-house and contractor program p & p consumption and shall show the quantity consumed (including losses) and the cost of the material for each propellant or pressurant consumed. Center logistics functions shall maintain and publish monthly plots of consumption vs. forecast for each major program element. This information shall be used by the logistics function in a manner which assures the continuous improvement of forecasting accuracy.

9.3 Funding Requirements

Each Center's Apollo Program logistics function shall assist its associated Apollo Program offices' Resources Control personnel in systematically determining propellant funding requirements. Funding requirements for propellants shall be shown as a separate line item for each major program element (system) in support of Program Operating Plans and other required program budgetary submissions. Projections shall be based on the most recent forecast of quantitative requirements multiplied by the anticipated unit cost of the specific propellant or pressurant programed for use at the location involved.

9.4 Requirements-Resources Studies

Center Apollo Program logistics functions shall conduct periodic reviews of program p & p requirements forecasts and available resources to determine adequacy of propellant and pressurant supply. Studies for each major propellant and pressurant shall, as a minimum, be conducted annually as well as for each significant program change. Indicated shortages or surplus capacity shall be corrected if in the area of the Center's responsibility. Indicated shortages in areas beyond the Center's responsibility

9.4 (Cont.)

jurisdiction shall be reported immediately to the Apollo Program Office. Each Center's logistics function shall also initiate and conduct periodic economic studies of alternate supply and/or delivery modes to ensure advantageous utilization of the most economic modes available. Salient conclusions (and their basis) reached by the performance of these studies are to be documented and recorded.

9.5 Propellant and Pressurant Acquisition

Acquisition management for Apollo Program propellants and pressurants requirements is the responsibility of the requiring Center's Apollo Program logistics function. The logistics function may delegate this responsibility to a contractor or may supply the propellant to the contractor as Government-furnished propellant (GFP).

a. Mode of Supply - At the time of Apollo end item, system, or major component contract and/or subcontract award, a decision shall be made between use of Government-furnished propellants and pressurants (GFP) or contractor-furnished propellants and pressurants (CFP). Center Apollo Program logistics function guiderules for this decision shall be developed and documented and are to include due consideration of the type and quantity of propellants and pressurants required, the duration of the requirement, the availability of a Government-controlled supply source, the availability of commercial product, the comparative costs including contractor's overhead, fee, etc., in the case of CFP, and the contractor's demonstrated ability to receive and handle program propellants and pressurants.

b. Apollo Center Propellant and Pressurant Procurement - When Government-furnished propellants and pressurants are utilized the cognizant program logistics function shall take the

necessary steps to assure that they are provided within program schedule time constraints. In accomplishing this, the advantages of using existing Government-owned or controlled propellant manufacturing facilities and existing Government supply support systems shall be considered and evaluated. In the event Government sources are not available or it has been determined that it would not be in the best interest of the Government, to use the existing resources, the Center may elect to procure the needed propellant or pressurant from commercial sources. When procuring from commercial sources, the guidelines of (c) and (d) below will be used. Construction of Government facilities for the manufacture of propellants and pressurants in commercial quantities is prohibited.

c. Guidelines for Commercial Purchase of Propellants and Pressurants - Propellants and pressurants shall be purchased on basic supply contracts. Yearly "call" contracts shall be used for supplies readily available on the commercial market unless documented studies prove that multi-year and/or contracts with minimum purchases guaranteed are clearly advantageous to the Government. Contracts guaranteeing all or a part of a contractor's capital cost shall be avoided in procurement of material that is commercially marketable and in all cases, Apollo Program Office approval shall be obtained before entering into contracts of this type.

d. Exceptions to the Use of Existing Government Facilities or Support Systems - A Center, in exercising its responsibility to obtain propellants and pressurants for Apollo Program equipment requirements, may initiate direct commercial procurements in areas supported by existing facilities or supply support systems under the following conditions:

9.5 (Cont.)

(1) The Government facility is fully loaded and has no available capacity for the Apollo Program requirement.

(2) The quality of the product from the Government facility does not meet minimum Apollo Program quality requirements.

(3) The Apollo Program quantitative requirement is substantially higher than the available output from the Government facility and:

(a) The Government facility could not supply a significant portion of the Apollo Program requirement; and

(b) The Government facility could operate at an efficient level without the Apollo Program requirement.

(4) The cost to the Apollo Program of product from the existing Government facility would exceed the cost of product available to the Apollo Program in that location from commercial sources.

(5) The existing supply support system has inadequate capability in the area where Apollo Program support is required.

(6) The Apollo Program Center has determined and the Apollo Program Office has concurred that the Apollo Program schedules dictate direct control of the Apollo Program end item's propellant resources.

9.6 Funding for Propellant and Pressurant Purchases

Uniform procedures for the orderly and timely transfer of funds for the purchase of propellants and pressurants required by Apollo Program users shall be provided. These procedures shall be in accordance with applicable NASA Financial Management Directives and the regulations of the supply support agency providing the propellants and/or pressurants.

9.7 Propellant Logistic Operations

Each Center's Apollo Program logistics function shall establish ordering and inventory management procedures for use by its associated Center Apollo Program Offices, laboratories and contractors which are to be used for ordering and holding Government-furnished propellants and pressurants. These procedures shall ensure timely ordering and efficient inventory management and shall be in consonance with the supply support system utilized. Each program logistics function shall monitor propellant supply and shall advise its Apollo Program Offices and the responsible supply support system managers immediately of any pending disruption of Apollo Program propellant supply. During periods of propellant and pressurant shortage, the program logistics function shall provide counsel to its affected Apollo Program Offices and the respective supply support system managers with respect to the relative priorities of the Apollo Program end items affected and provide potential impact data of the affected programs.

9.8 Propellants and Pressurants Specifications Responsibilities

Each Apollo Program logistics function is responsible for ensuring that adequate propellant and pressurant specifications exist. Maximum use of existing propellant and pressurant specifications including Federal Specifications, Military Specifications and the specifications of other NASA Centers shall be made. Program logistics functions shall, in the case of each new propellant or pressurant requirement generated by an Apollo Program contractor or the responsible Apollo Program technical office, determine the applicability of existing specifications and the necessity of modifying an existing specification and/or writing a new specification.

9.8 (Cont.)

a. In cases where an existing specification can be modified to meet the new quality requirement, a cover sheet shall be provided stating the change and its applicability. A formal request for an amendment shall be made on changes having sufficiently wide applicability. Direct contact between Apollo Program Centers relative to specification changes is authorized. Proposed amendments to Federal Specifications, Military Specifications and NASA Specifications originated by other than Apollo Program Centers shall be forwarded to the Apollo Program Office for action.

b. MSFC is responsible for writing and maintaining specifications, when required, for propellants and pressurants primarily associated with launch vehicles. The following fluids are considered to be within the area of MSFC responsibility:

(1) Hydrogen, liquid and gaseous

(2) Oxygen, liquid and gaseous

(3) Nitrogen, liquid and gaseous

(4) Hydrocarbon Fuels

(5) Helium, gaseous

(6) Other propellants and pressurants primarily associated with launch vehicles

c. MSC is responsible for writing and maintaining specifications when required for propellants and pressurants primarily associated with Apollo Program spacecraft. These fluids will include:

(1) Nitrogen Tetroxide

(2) Hydrazine-Unsymmetrical Dimethylhydrazine

(3) Monomethylhydrazine

9.8 (Cont.)

(4) Other propellants and pressurants associated with manned spacecraft

9.9 Guideline for Specification Writing

Center Apollo Program Offices, when writing a necessary specification, will utilize the following guidelines:

a. Specification will define the minimum quality material that must be purchased to ensure proper functioning of the end item requiring the material. Normal degradation or improvement in quality with shipping, storage, and dispensing will be considered when establishing specification quality requirements.

b. Multiple specifications for a common material are to be avoided. Where possible, a single specification with multiple grades shall be utilized.

c. Provide as broad coverage as practical so as to include the requirements of other Apollo Program Centers and other NASA programs.

d. The specification shall be written with no unnecessary quality, quality assurance, or preparation for delivery requirements so as to permit suppliers to provide material of the necessary quality at the lowest price consistent with program requirements.

9.10 Use Limits

Each Apollo Program logistics function shall assure that "use limits" are established and provided to program users which define the minimum quality of propellants and pressurants at various given points in the propellants and pressurants transportation, storage, and use cycle. The program logistics function shall

9.10 (Cont.)

assist its associated program organizational elements in establishing propellant and pressurant "use limits." Use limit values shall reflect the normal change in quality of propellants and pressurants with repeated handling. As a minimum, "points" where the quality to be defined should include the bulk storage of the using activity, the run tank of the Apollo component to be tested, the run tank of the Apollo system, stage, or end item to be tested, and the launch facility loading tanks.

9.11 Propellant and Pressurant Transportation

Apollo Program Center propellant and pressurant transportation requirements are delineated in this Plan Part II, Section 8.0. Apollo Program Centers will comply with guidance provided therein in all areas of their propellant and pressurant responsibility.

9.12 Propellant and Pressurant Handling and Safety

Each Apollo Program logistics function shall assure that propellant and pressurant handling procedures are established and provided which ensure safe and economical handling of propellants and pressurants by Apollo Program participants. Specific requirements for handling individual materials are contained in the January 1963 DoD publication, "The Handling and Storage of Liquid Propellants." Figure 9.12-1 references applicable portions of this document which pertain to Apollo propellants and pressurants and is provided.

9.13 Propellants and Pressurants Training Program

Each Center Apollo Program logistics function shall assure that the program's requirements for propellants and pressurants handling are established and covered by appropriate training programs and/or procedures which assure the safe and economical handling of program propellants and pressurants by all personnel

9.13 (Cont.)

who will be engaged in handling these products at program locations. Each NASA Center is to coordinate its respective training program requirements with contractors and other Centers to assure that the required training is provided at the lowest practical cost.

9.14 Safety Surveillance

Each Center shall establish the requirement for and shall implement an Apollo Program Propellant Safety Surveillance Program designed to prevent unsafe propellant transportation, storage, and handling practices. As a minimum, this program shall provide surveillance or ensure that surveillance is being provided in the form of a recognized formal safety surveillance program in the following areas:

a. All propellant-pressurant operations related to the Apollo Program being conducted on a NASA Center, manufacturing facility or test facility.

b. Propellant operations being conducted at non-NASA Government installations where Apollo Program equipment and/or personnel are located.

c. Propellant and pressurant operations being conducted by an Apollo Program contractor on an Apollo Program item.

d. Propellant and pressurant transportation to an Apollo Program site (KSC, MTO, SACTO, MSC, etc.) from a commercial source under an Apollo Program Center issued supply contract.

9.15 Quality Maintenance

Each Center's Apollo Program logistics function shall take the necessary steps to ensure the minimum degradation of its Apollo Program propellant or pressurant quality when received, stored

9.15 (Cont.)

and dispensed for use. These steps will include but will not be limited to:

a. A training program that may be a part of the basic handling and safety program that will stress practices that will preserve propellant and pressurant quality.

b. Provide guidance to Apollo Program Center and contractor facility design and construction offices that will assist them in construction of facilities that ensure preservation of the propellant and pressurant quality.

c. A program of continual quality monitoring incorporating sampling and chemical analysis at all points in the installation's propellant or pressurant storage handling and use cycle.

9.16 Propellants and Pressurants Facilities Review

Each Center's Apollo Program logistics function shall review its existing Apollo Program propellant and pressurant facilities to determine their adequacy from the standpoint of propellant logistic considerations. These considerations shall include capacity, reliability, efficiency, and safety. Each Center shall take corrective action where necessary to eliminate unsatisfactory conditions.

9.17 Future Propellants and Pressurants Facility Guidance

Each Apollo Program logistics function shall specify and provide control criteria to its associated Center and contractor facilities offices relative to the Apollo propellant and pressurant logistics requirements. This criteria will address itself to but is not limited to the following:

a. The sizing of propellant loading tanks when the tanks are part of the logistic system.

9.17 (Cont.)

b. The sizing of propellant and pressurant storage facilities.

c. The sizing and technical specifications of intra-Center propellant and pressurant transportation.

d. Use of special up-grading (clean-up) features in test and launch facilities to permit the bulk (most economical) grade of propellant or pressurant to be used regardless of the quality requirements of select subsystems.

e. Use of separate propellant or pressurant loading facilities for a common material in test or launch facilities when various quality levels are required and up-grading of quality for select subsystems is not practical.

SPECIFIC REQUIREMENTS FOR THE HANDLING AND TRANSPORTATION OF APOLLO PROPELLANTS AND PRESSURANTS

NOTE: REQUIREMENTS ARE CROSS REFERENCED TO THE DOD PUBLICATION 'THE HANDLING AND STORAGE OF LIQUID PROPELLANTS - JANUARY 1963' BY PAGE NUMBER

SECTION	PARA-GRAPH	FUNCTION/ELEMENTS	FUELS				OXIDIZERS		PRESSURANTS			
			Cryogenic	Non-Cryogenic			Cryogenic	Non-Cryogenic	Gaseous		Cryogenic	
			LH_2	RP-1	A-50	MMH	LOX	N_2O_4	N_2	He	LN_2	LH_e*
1.		General Properties	139	125	111/299	177	233	217	273	273	205	205
	1.1	Chemical Composition										
	1.2	General Appearance										
	1.3	Chemical Nature										
	1.4	Physical Properties										
	1.5	Solubility										
	1.6	Stability										
	1.7	Compatibility										
2.		Hazards	140	126	112/300	178	233	218	274	274	206	206
	2.1	Health										
	2.2	Fire										
	2.3	Explosion										
3.		Safety Measures	141	128	113/301	179	235	219	274	274	206	206
	3.1	General										
	3.2	Education of Personnel										
	3.3	Personal Protection										
4.		Handling, Transfer & Storage	142	129	114/302	180	236	221	275	275	207	207
	4.1	General										
	4.2	Materials										
	4.3	Equipment										
	4.4	Main Storage										
	4.5	Ready Storage										
	4.6	Transfer Procedures										
	4.7	Spills, leaks, decontamination										

FIGURE 9.12-1

PAGE 1 OF 2 PAGES

SPECIFIC REQUIREMENTS FOR THE HANDLING AND TRANSPORTATION OF APOLLO PROPELLANTS AND PRESSURANTS

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			LH_2	RP-1	A-50	MMH	LOX	N_2O_4	N_2	He	LN_2	LH_e*
5.		Shipping	146	133	118/306	183	241	226	280	280	212	212
	5.1	Applicable Laws										
	5.2	Marking										
	5.3	Packaging										
	5.4	Accident Procedure										
	5.5	Loading & Unloading Procedure										
6.		Recommended Safety Instructions	147	134	119/307	184	241	226	281	281	212	212
7.		References/Specifications	147	136	119/310	186	243	227	281	281	214	214

*The requirements for LH_e will generally parallel those for LN_2 except that special venting is required and the container requirements are considerably more stringent because of the high volatility of liquid helium.

FIGURE 9.12-1

APPENDIXES

INDEX FINDER

APPENDIX (A) GLOSSARY OF TERMS

APPENDIX (B) ABBREVIATIONS

APPENDIX (C) PERSONNEL TYPE POSITION DESCRIPTIONS

APPENDIX (D) PERCEPTUAL, JUDGMENTAL, AND MOTOR SKILL CODES

APPENDIX (E) PROGRAM ELEMENT NUMBERING SYSTEM

APPENDIX (F) LISTING OF THE NOUN NAME OF COMPONENT PARTS AND THE CORRESPONDING LETTER CODE

APPENDIX (G) END ITEM LOGISTICS REQUIREMENTS SUMMARY

794-693 O-65-19

APPENDIX A

GLOSSARY OF TERMS

Adjust - To manipulate controls to return equipment to prescribed operating tolerances.

Aerospace Ground Equipment - All equipments required on the ground to make an aerospace system operational in its intended environment. AGE includes OGE and MGE.

Aerospace Vehicle Equipment - Flyable equipment which is part of the manned or unmanned vehicle which ultimately operates in the aerospace environment.

Apollo - A term generally used to describe the NASA Manned Lunar Landing Program, but specifically used to describe the effort devoted to the development test and operation of the space vehicle for long duration Earth orbit, circumlunar, lunar landing and return flights.

Apollo Program Center - A NASA Field Center performing a major function in the management of the Apollo Program.

Apollo Program Development Plan - Description of the Apollo mission and of the efforts required to support the Apollo mission.

Apollo Program Element - A NASA organization, office, etc., that has a recognized Apollo Program responsibility.

Assembly - Two or more parts or subassemblies or any combination thereof, replaceable as a whole and joined together to perform a specific function.

Baseline - The prerequisite information which serves as a foundation for accomplishing subsequent activities.

Bill of Lading, Commercial (CBL) - A nonnegotiable document by which a transportation line acknowledges receipt of freight and

contracts for its movement. Generally, this document is used by government contractors for prepayment of freight charges under F.O.B. destination delivery terms.

Bill of Lading, Government (GBL) - The GBL is a limited liability contract covering transportation of property from one place to another. It is a receipt, identifies the consignee, serves as proof the shipment was delivered to consignee and serves as a basis for collection and audit of charges.

Calibrate - The comparison of equipment with other equipment which has been established as an authorized or recognized standard.

Certificate of Public Convenience and Necessity - Authority or certificate granted by the Interstate Commerce Commission to common carriers by motor vehicle, water and freight forewarders to operate in interstate commerce.

Checkout - The tests necessary to establish that the equipment is in a serviceable status.

Common Carrier - A person or company engaged in the business of transporting persons or property for compensation on an impartial basis.

Component - An article which is normally a combination of parts, subassemblies, or assemblies and is a self contained element within a complete operating equipment.

Concealed Damage - A damage to the contents of a package which is in good order externally.

Consignee - A receiver of freight.

Consignor - A shipper of freight.

Contract Carrier - A person or company other than a common carrier who, under special and individual contracts and agreements, transports passengers or property for compensation.

Contract End Item - (See end item.)

Critical Component Detail Specifications - Detail specifications which are required for components which have been identified in a contract end item detail specification as "engineering critical components" and/or "logistics critical components."

Critical Task - A task involving a substantial probability of human error that may result in damage to the system, degradation of mission success, substantial time loss or injury to personnel.

Cross Hauling - The shipment of material of the same kind in reverse directions, a practice which results in the dissipation of transportation funds and the nonproductive use of transportation resources.

Cross-training - The technical training that one Apollo organization or contractor requires from or provides to another Apollo organization or contractor.

Cryogenics - A liquid whose chemical elements or molecular combinations of elements have been converted from a gaseous to a liquid state by the application of intensive refrigeration. The boiling point or condensation points of these liquids, that is the temperatures at which they will physically change from a liquid to a gas or from a gas to a liquid depending on whether heat is applied or withdrawn, are - 297^{o}F for liquid oxygen, - 320^{o}F for liquid nitrogen and - 423^{o}F for liquid hydrogen.

Data Storage and Retrieval System - An automated library system in which the data is stored and/or indexed in such a manner that on request a systematic rapid search will be accomplished to identify the material demanded. Copy of requested data is delivered by some systems.

Days - Calendar days.

Demurrage - A penalty charge made on cars, vehicles or vessels held by or for consignors or consignees for loading or unloading for shipping instructions or for any other purpose. (Ordinarily, adequate time for loading, unloading, etc., is allowed prior to the time demurrage takes effect.)

Diversion - A change in destination and/or consignee effected while material is enroute.

End Article/End Item - A physical element of the Apollo Program Space Vehicle System (spacecraft module, flight stage, launch vehicle AGE, etc.) It is a functional entity physically related and selected for the purpose of system development, procurement, and logistics. The following criteria shall be used in the identification of an end item:

a. An end item shall be procurable by the government to a single specification.

b. An end item shall be identified by a single top drawing which has been prepared in conformance with appropriate military specifications.

c. An end item shall be identified by a separate and distinct part number and serial number.

d. The physical and functional characteristics of an end item shall be such that its configuration can be controlled and documented economically regardless of the number of changes approved and/or incorporated therein.

e. The location of the distinct/separate parts of an end item should be such that they are not remotely located with respect of one part to another, i.e., black boxes should be located in the same AVE system compartment, same maintenance area, etc.

f. By definition, magnetic tapes and card decks used with checkout equipment are classified as end items and subject to change control.

Environmental Conditioning - The conditioning or adapting processes by which equipment or materials are made to conform to the environment(s) in which they are to be used.

Environmental Constraints - Limitations or requirements imposed by environment.

Facility - A real property improvement, e.g., buildings or structures. This includes its Real Property Installed Equipment. Facility includes: (1) Mission Support Real Property which is system peculiar and required for direct mission support (VAB, LCC, fuel storage), and (2) Administrative and Support Real Property which are not critical to the mission (cafeterias, warehouses). As used in this Plan, the term facility means Mission Support Real Property.

FOB Destination - The destination at which supplies are to be delivered to the consignee at destination at the expense of the contractor.

FOB Origin - The point at which the contractor is responsible for loading the supplies on the carrier's vehicle, wharf or freight station in the same or nearest city providing the service specified by The Government.

Fragility - The quality or characteristic of delicacy of material or construction which requires careful handling.

Handling - Includes the functions of disassembly and reassembly, covering and uncovering, intra-plant movement, loading and unloading, blocking and bracing, tie down depackaging and depreserving and inspection which takes place during manufacturing and test, loading and delivery phases of the transportation cycle.

Induced Environment - The environment created to safely transport an item within the allowable limits of temperature, humidity and shock.

Interface - The point at which responsibility for a continuing function changes from one authority to another, or the demarcation line between two physical elements which must have continuity of form, fit, or function.

Intra-Plant Movement - Movement of material within the immediate vicinity of a manufacturing, test or terminal area.

Line Haul - Movement of personnel or material over the routes of a transportation line from one town or city to another town or city. Does not include local movements, drayage or intra-plant movements.

Loadmaster - The supervisor in charge of loading and unloading cargo aircraft who is responsible for determining the CG of the aircraft and who has final approval on loading/unloading sequences, placement and securing of loads.

Logair - Air Force contract logistic airlift system provided by the Air Force for the movement of urgent material between points in the contractual United States.

Logistics Requirements Summary - The integration of the logistics baseline and maintenance analyses to document and identify program needs.

Long Lead Items - This term is normally used to identify an item which requires an extensive acquisition time cycle due to such factors as design complexity and/or scarce material supplies, limited production capability, lengthy manufacturing and/or test processes. These items usually require early or special procurement action to make projected schedules.

Maintainability - The quality of the combined features equipment design and installation which facilitates the accomplishment of inspection, test, servicing, repair and overhaul with minimum time, skill and resources.

Maintenance - The function of retaining material in or restoring it to operating condition. It includes repair cycle activities at any level as well as the servicing cycle.

Maintenance Activities - The maintenance actions required to restore a system or equipment to a serviceable condition (i.e., localize, isolate, remove and replace, etc.)

Maintenance Ground Equipment - The ground support equipment which is used in support of maintenance operations for vehicle, payload, stages, OGE, facilities, or other MGE.

Major Project Contractors - Contractors performing design fabrication, test, development, operations and maintenance on major AVE and AGE systems such as:

(a) Launch Vehicles - Stages and instrument units.
(b) Payloads - Spacecraft and significant subsystems.
(c) Operational Ground Equipment - Mechanical and electrical equipment used to support the vehicle operations.
(d) Engines - Vehicle, spacecraft primary propulsion systems.

Materiel - Consists of normal end items and general support type material (spares, housekeeping supplies, hand tools, etc.). Items of materiel are generally below the end item level in the hardware structure of a system for which standard commercial packaging, packing and handling will suffice and that can be handled by commercial common and contract carriers.

Mean-Time-Between-Failures - The average operating hours between failures when the system/equipment is used in its intended environment.

Monitor - To observe the operation of equipment through sensory perception.

National Motor Freight Classification - A publication which classifies articles which move by truck and which establishes ratings from which freight rates are determined.

Operability - The condition of being capable of proper operation.

Operate - To activate, regulate or change equipment performance by manipulation of controlling devices.

Operating Authority - The written authority issued by the Interstate Commerce Commission which specifies the types of commodities a carrier can handle and the routes over which a carrier is authorized to operate.

Operation - The lowest level element in an activity which generates support requirements.

Operational Ground Equipment - A functional part of the ground system which operates with or in direct support of the aerospace vehicle or end item as an essential mission element.

Operations and Maintenance Instruction - Data specifically organized to cover assembly and checkout, test, operating and maintenance of vehicle system/equipment. This includes items commonly known as technical manuals, support manuals, O & M manuals, handbooks or data packages.

Outsize Cargo - Any item of material or equipment which exceeds 8 feet in height or 8 feet in width or 32 feet in length or 11,200 pounds including its packaging and packing.

Overpack - Cargo too heavy for the package or carton.

Part - One piece, or two or more pieces joined together and normally not subject to disassembly without destruction of the designed use.

Personnel Requirements Information - Personnel data used in planning for system personnel use and training.

Personnel Task - The least increment of an operation involving human action.

Physcial Constraints - Limiting physical parameters or requirements.

Premium Transportation - A means or method of transportation other than the one that would provide transportation at the minimum cost. Such services are air freight, air express, REA express.

Preparation for Delivery - Includes the functions of cleaning, drying, preserving, packaging, packing, working and inspection which must be satisfied to protect end items against physical damage, loss, deterioration, corrosion, degradation and substitution.

Pressurant - An inert chemical used to pressurize and inert space vehicle propellant tanks. Pressurants generally are used in the gaseous state but frequently are delivered and stored in the liquid state.

Prime Equipment End Item - The more complex contractor designed contract end items that require extensive functional tests while in the assembled condition.

Prime Spares - These are spares which are used to perform first level maintenance activities and for which a supply is maintained at the site location.

Proficiency Level - The level of skill with which personnel perform prescribed tasks.

Program Critical Item - A part for which the lack of immediate issue on-call at the demand source would adversely affect program schedules, safety or reliability.

Program Integration Contractor - A contractor with mission contract responsibility to support a program by the evaluation, monitoring and general technical and program integration of major program elements toward a common goal.

Propellant - The process of furnishing equipment and spares to support post-manufacturing Apollo Program test and launch operations.

Quantification - The determination, expression, or measurement of a quantity.

Quicktrans - A U. S. Navy contract air cargo service which provides logistic support to naval shipyards, air stations, supply activities and operating bases within the contractual limits of the United States.

Reactivate - To return the equipment to use and ascertain that equipment operation is normal.

Real Property Installed Equipment - Government owned or leased equipment that is physically attached to, integrated into, or built into NASA property and normally is procured through the NASA construction program and installed as part of the construction effort.

Reconsignment - Any change, other than a change in the route, made in a consignment before the arrival of goods at their billed destination; or any change made in a consignment after the arrival of goods at their billed destination when the change is accomplished under conditions which made it subject to the reconsignment rules and charges of the carrier.

Refurbishment - The cleaning, repair, replacement of parts, and other renovation activities required to restore equipment or a facility to usable condition.

Reparable - A spare part capable of being repaired or overhauled which, because of unit cost, lead time, physical characteristics, and/or other considerations, is deemed technically and economically feasible to repair.

Repair Turn-Around Time - The total accumulated time required to package and ship an item to the repair facility, accomplish the repair, and return the repaired item to the supply system.

Routing - The designation of the mode, carrier and course of direction a shipment shall move.

Scheduled Maintenance (Preventive Maintenance) - Any planned maintenance actions deemed necessary to enhance the functional success of the item.

Section 22 Quotation (Rate Tender) - A tender of rates, charges or arrangement made by commercial carriers for the carriage, storage, or handling of property, or the transportation of persons, pursuant to the provision of Section 22 of the Interstate Commerce Act (49 ICC 22) or other appropriate statutory authority.

Selective Item - A Spares Cost Category I or Cost Category II reparable spare part.

Sequence of Operations - The sequence of all functions necessary to transport, assemble and checkout, test and launch the Aerospace Vehicle.

Shelf Life - The anticipated time during which an unused item retains its capacity to operate normally.

Shock Mitigation - The reduction or minimizing of the effect of shock.

Spare Part - An item capable of separate supply and replacement which is required for the maintenance, overhaul or repair of the article for which it was provisioned.

Spare Parts Category - A subdivision of spare parts, as follows:

(a) Maintenance Parts are those spare parts (except for bulk items and standard parts) which can be installed in an end item at the outplant Apollo Program test and launch sites without jeopardizing the reliability of the end article supported, using the programed capabilities of on-site personnel, equipment and facilities.

(b) Repair Parts are those spare parts (except for bulk items and standard parts) which are required to return reparable maintenance parts to a serviceable condition.

(c) Bulk Items and Standard Parts are raw and semi-fabricated materials and low-cost items which are commercially available or which conform to the requirements of Government standards. They include:

(1) Raw and semi-fabricated materials, such as sheet, bar, rod, tubing, extrusions; and paint, lubricants and other preservative compounds.

(2) Industry standards parts which are low cost, non-reparable and readily available in the open market from established sources for off-the-shelf procurement.

(3) All Government standard parts made to MS-AN-JAN-USAF-MIL-NAF-NAS specifications and which are identified by MS-AN-JAN-USAF-MIL-NAF-NAS part numbers.

System - Any combination of parts, assemblies and sets joined together to perform a specific operational function or functions.

Trade Off Studies - Studies conducted to evaluate or compare alternative parameters, materials, or procedures.

Traffic Management - The direction, control and supervision of all functions incident to the effective and economical obtainment and use of freight and passenger transportation services.

Transit Privileges - A service granted on a shipment enroute, such as storage, refining, fabrication, etc., where a through rate is applied instead of a combination of rates plus the addition of an in-transit charge.

Transportability - The capability of efficiently and effectively transporting an end item of equipment or component thereof, over existing or planned railways, highways, waterways, oceans and airways, either by carrier, towed, or by self-propulsion and includes consideration of the sensitive or dangerous nature of the item as offered for transport.

Transportation Mode - A type of transportation such as rail, truck, air, water, etc.

Uniform Freight Classification - A publication which classifies articles which move by rail and which establishes ratings from which freight rates are determined.

Unit - Anything considered as complete in itself, but functioning as a part of a higher indenture of equipment.

Unscheduled Maintenance (Corrective Maintenance) - Any maintenance which is required as a result of malfunction, regardless of the circumstances under which these malfunctions were discovered.

Utility-Type Manuals - Low cost paperback manuals which have been produced in a manner such as blue lines, to be used as working copies during verification.

Verification - An effort conducted by the contractor and approved by NASA agencies to confirm that all technical requirements of the program have been satisfied. Equipment, facilities, operations and maintenance instructions, trained personnel and equipment, and human performance are evaluated during verification in order to substantiate system performance. This evaluation will confirm design or lead to redesign and refinement of techniques and procedures.

APPENDIX B

ABBREVIATIONS

A-50	Aerosene 50: A 50-50 mix by weight of UDMH (Unsymetrical Dimethylhydrazine) and hydrozine
ABSME	American Bureau of Shipping for Marine Equipment
ADI	Apollo Documentation Index
AGE	Aerospace Ground Equipment
APCI	Air Products Company, Inc.
AVE	Aerospace Vehicle Equipment
CAB	Civil Aeronautics Board
CEI	Contract End Item
CFP	Contractor Furnished Propellant
CG	Center of Gravity
DOD	Department of Defense
DRD	Documentation Requirements Descriptions
DTMS	Defense Traffic Management Service
EAM	Electrical Accounting Machine
EDPE	Electronic Data Processing Equipment
EIC	End Item Criteria
FAA	Federal Aviation Agency
FMB	Federal Maritime Board
F.O.B	Free on Board
GBL	Government Bill of Lading
GFP	Government Furnished Propellant
GHe	Gaseous Helium

GIE	Ground Instrumentation Equipment
GN_2	Gaseous Nitrogen
GSA	General Services Administration
ICC	Interstate Commerce Commission
KSC	Kennedy Space Center
LCC	Launch Control Center
LH_2	Liquid Hydrogen
LHe	Liquid Helium
LN_2	Liquid Nitrogen
LO_2, LOX	Liquid Oxygen
LSD	Landing Ship Dock
MATS	Military Air Transport Service
MGE	Maintenance Ground Equipment
MILA	Merritt Island Launch Area
ML	Mobile Launcher
MMH	Monomethylhydrazine
MSC	Manned Space Center
MSFC	Marshall Space Flight Center
MSRP	Mission Support Real Property
MSTS	Military Sea Transportation Service
MTBF	Mean Time Between Failures
MTMS	Military Traffic Management and Terminal Service
MTO	Mississippi Test Operations
NASA	National Aeronautics & Space Administration
NMFC	National Motor Freight Classification
NMI	NASA Management Instruction
N_2O_4	Nitrogen Tetroxide

NOI	Not Otherwise Indexed
OGE	Operational Ground Equipment
PDP	Program Development Plan
P'DP	Project Development Plan
PEN	Program Element Number
PERF. CRIT.	Performance Criticality
PNR	Pre-negotiation Review
P and P	Propellants and Pressurants
QC	Quality Control
R&D	Research & Development
RF	Radio Frequency
RFP	Request for Proposal
RP-1	Kerosene
RPIE	Real Property Installed Equipment
SACTO	Sacramento Test Operations
TRE	Training Equipment
UCR	Unsatisfactory Condition Report
UDMH	Unsymetrical Dimethylhydrazine
UFC	Uniform Freight Classification
USCG	U.S. Coast Guard
VAB	Vertical Assembly Building

APPENDIX C

PERSONNEL TYPE POSITION DESCRIPTIONS

The electrical field, power systems personnel type position descriptions included have been adapted from the U.S. Department of Labor's Dictionary of Occupational Titles.

Type 143 Electrical Master, Launch Vehicle Systems

Applies principles of AC and DC electrical circuits, testing procedures, mathematics, physics, and related subjects to lay out, build, test, trouble shoot, repair, and modify developmental, prototype, and production electrical equipment associated with launch vehicle systems:

(1) Discusses layout and construction problems with the Electrical Engineer and draws sketches to clarify design details and functional criteria of electrical units. Assembles breadboards or complete prototype model according to engineering instructions, blueprints, specifications, and knowledge of electrical systems and components. Recommends changes in circuitry, equipment, or installation specifications to simplify assembly and maintenance. Sets up standard and special test apparatus or contrives test equipment to conduct functional environmental, and life test used to evaluate performance and reliability of prototype and production models.

(2) Adjusts, calibrates, and aligns circuit components, and records effect on unit performance.

(3) Writes technical reports to describe systems operating characteristics, malfunctions, deviations from design specifications and functional limitations for consideration by professional engineering personnel in broader determinations affecting systems design and laboratory procedures.

(4) Has knowledge of system equipment and personnel hazards associated with electricity and utilizes necessary safeguards.

(5) May operate bench lathes, drills, and other machine tools to fabricate nonprocurable items such as specially wound motors and generators with peculiar mounting characteristics.

(6) May check out newly installed equipment to evaluate system performance under actual operating conditions.

(7) Instructs and supervises lower grade technical personnel.

Type 142 Electrical Journeyman, Launch Vehicle Systems

Tests, repairs, and adjusts launch vehicle system electrical equipment by following blueprints and specifications in prototype or production models:

(1) Tests faulty equipment and applies knowledge of electrical units and systems to diagnose cause of malfunction. Tests components and circuits to locate defects by using special test sets and instruments, such as voltmeters, and ammeters. Replaces defective components and wiring by using hand tools and soldering irons. Observes post-repair tests to ascertain that the system operates satisfactorily.

(2) Calibrates, aligns, and adjusts equipment according to specifications.

(3) Maintains records of repairs and tests. Reports malfunctions for possible corrective action.

(4) May make connections between installed components.

(5) Is aware of and observes the safety precautions associated with the system.

(6) Supervises lower grade personnel.

Type 141 Electrical Helper, Launch Vehicle Systems

Repairs electrical equipment associated with launch vehicle systems.

(1) Effects repair by following explicit instructions, written or verbal, when the malfunction is isolated to a component by a fault display or other means of positive identification.

Performs self test procedures to check repair. Repairs are usually limited to component or wiring replacement by using hand tools and soldering irons.

(2) Assists higher grade technical persons in the performance of their duties when more than one person is required for the task.

(3) Performs more complex tasks under direct supervision.

(4) Is safety conscious.

APPENDIX D

PERCEPTUAL, JUDGMENTAL, AND MOTOR SKILL CODES

Perceptual, judgmental and motor skill codes are used to indicate the level of competence required to perform a task. These entries are made for each personnel task or operation which is shown. They are used to indicate demands which may require training, environmental control or human engineering evaluation in order to prevent degradation of reliable system performance, because of unusual demands on personnel.

A three digit code is used to indicate these demands. The first digit represents the degree of perceptual skill required, the second the judgmental and the third represents the motor skill required. Three levels of skills are defined for each area of demand. The greater the demand the higher the code number assigned.

1.0 PERCEPTUAL SKILL CODE

1 - Perceptual skill, low demand. The perceptual ability required would be the sensing of a non-precision indication, distinguishing primary and secondary colors, coarse and smooth textures, odor or no odor, hot or cold, movement or no movement, etc. These preceptions are of a coarse, non-critical type which may be readily learned, if not already within the capability of the personnel specified.

2 - Perceptual skill, medium demands. The perceptual ability required would be the accurate, and/or coordinated sensing of one or more fixed or variable indicators such as quantity indications of an instrument, differences of weight, relative frequency, and rates of movement. The what, where and how of perception may be acquired through training, trainers, demonstration, and technical data.

3 - Perceptual skill, high demand. This requires precise, critical and/or coordinated sensing of one or more fixed or variable indicators such as distinguishing quality indications, relative motion, degrees of comparison, simultaneous or time critical events, pressure differences, volume of sound, frequency rates, and direction of movement. Complex perceptual skills such as these may be acquired by training and repetitive practice on training equipment or operational hardware to develop and maintain proficiency.

2.0 JUDGMENTAL SKILL CODE

1 - Judgmental skill, low demand. Readily learned by familiarization training, if not already within the normal capacity. The decisions or inference do not require extensive recall or relevant knowledge. Resolution of problems at this level would be nonprecise determinations such as go, no-go, up or down,

more or less, good or bad, all or none, etc.

2 - Judgmental skill, medium demand. Skills acquired through training, training equipment, demonstration, and/or technical data. The decision or inferences require recall of relevant knowledge and/or experience. The experience or knowledge necessary for adequate decisions would be the detail procedures or accurate measurements in accomplishing activities such as assembling, disassembling, installing, removing, inspecting, testing, operating, adjusting, computing, servicing, etc.

3 - Judgmental skill, high demand. Acquired by training, study and/or demonstration; maintained by continuous or repetitive practice and performance or study; and by use of training equipment, operational equipment, and technical data. Decision requires extensive recall and understanding of relevant and precise knowledge and/or experience. Knowledge required would be on the theoretical or abstract levels. Type of decisions necessary would be precise and detailed analyzing, correlating, organizing and sequencing of processes and/or data for activities such as variable emergency procedures, trouble shooting, planning, scheduling, designing, researching, developing.

3.0 MOTOR SKILL CODE

1 - Motor skills, low demand. Non-precise manipulations which can be readily learned by demonstration if not already within normal capacity.

2 - Motor skills, medium demand. Coordinated, precise manipulations that may be learned through training, training equipment, and/or supervised performance. These acts would be accurate, coordinated, and timely motions to achieve optimum results.

3 - Motor skill, high demand. Requires a high degree of dexterity for precise, coordinated movement in varied responses to sensory cues. These acts would require training and repetitive practice on training or operational equipment in order to maintain proficiency.

APPENDIX E

PROGRAM ELEMENT NUMBERING SYSTEM

Program Element Numbers (PEN's) are the key to the management accounting system. All functional systems, equipment and components thereof, on the Apollo Program will be assigned numbers. As the functional classification proceeds from the system to lower levels of detail (lower indenture), additional digits will be added. The Program Element Numbering System will thus be an indentured listing of all functional elements and will be compatible for use in electronic data processing methods. The PEN system selected for use will provide a systematic and program-wide integrated identification of the elements of the program. This selected system is to provide an effective means of communication between NASA and contractor program participants.

An illustrative sample numbering system which could be developed for use for the Saturn V Launch Vehicle is shown as Figure E-1. The numbering system will be developed for all Apollo Program hardware and will be capable of including personnel subsystems, documentation, etc. As the Program Element Number level progresses to lower functional indentures, a system of groups of digits separated by decimals or ALPHA coding will be used for identification. The pyramid effect of indenturing will thus be taken into account.

The Pumping Unit, S-IC Inert Prefill has been selected as an illustration. The Program Element Number is developed as follows:

2	Saturn System
22	Saturn V Operational Ground Equipment
221	Saturn V AGE, S-IC Stage
2213	Saturn V AGE, S-IC Stage, Servicing Equipment
2213.02	Saturn V AGE, S-IC Stage, Servicing Equipment Engines
2213.02.03	Saturn V AGE, S-IC Stage, Servicing Equipment, Engines, Inert Prefill Unit

2213.02.03.01	Saturn V AGE, S-IC Stage Servicing Equipment, Engines, Inert Prefill Unit, Pumping Unit
2213.02.03.01 C	Saturn V AGE, S-IC Stage Servicing Equipment, Engines, Inert Prefill Unit, Pumping Unit Spares List

LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
2 SATURN V SYSTEM	21 SATURN V LAUNCH VEHICLE	211 S-IC STAGE	2111 STRUCTURES
			2112 PROPULSION AND MECH SYSTEM
			2113 ELECTRICAL SYSTEMS
			2114 INSTRUMENTATION SYSTEMS
			2115 FLIGHT CONTROL SYSTEMS
		212 S-II STAGE	2121 STRUCTURES
			2122 PROPULSION AND MECH SYSTEM
			2123 ELECTRICAL SYSTEMS
			2124 INSTRUMENTATION SYSTEMS
			2125 FLIGHT CONTROL SYSTEMS
		213 S-IVB STAGE	2131 STRUCTURES
			2132 PROPULSION AND MECH SYSTEM
			2133 ELECTRICAL SYSTEMS
			2134 INSTRUMENTATION SYSTEMS
			2135 FLIGHT CONTROL SYSTEMS
		214 INSTRUMENT UNIT	2141 STRUCTURES
			2142 MECHANICAL SYSTEMS
			2143 ELECTRICAL SYSTEMS
			2144 DATA SYSTEMS
			2145 TRACKING SYSTEMS
			2146 GUIDANCE AND CONTROL SYSTEMS
	22 SATURN V AEROSPACE GROUND EQUIPMENT	221 S-IC STAGE AGE	2211 TEST AND CHECKOUT EQUIPMENT
			2212 TRANSPORTATION AND HANDLING EQUIPMENT
			2213 SERVICING EQUIPMENT
			2214 AUXILIARY EQUIPMENT
		222 S-II STAGE AGE	2221 TEST AND CHECKOUT EQUIPMENT
			2222 TRANSPORTATION AND HANDLING EQUIPMENT
			2223 SERVICING EQUIPMENT
			2224 AUXILIARY EQUIPMENT
		223 S-IVB STAGE AGE	2231 TEST AND CHECKOUT EQUIPMENT
			2232 TRANSPORTATION AND HANDLING EQUIPMENT
			2233 SERVICING EQUIPMENT
			2234 AUXILIARY EQUIPMENT
		224 INSTRUMENT UNIT AGE	2241 TEST AND CHECKOUT EQUIPMENT
			2242 TRANSPORTATION AND HANDLING EQUIPMENT
			2243 SERVICING EQUIPMENT
			2244 AUXILIARY EQUIPMENT
		225 LAUNCH VEHICLE AGE	2251 CHECKOUT AND LAUNCH EQUIPMENT
			2252 TRANSPORTATION AND HANDLING EQUIPMENT
			2253 SERVICING EQUIPMENT
			2254 AUXILIARY EQUIPMENT
			2255 FIRING ACCESSORIES
			2256 LUT ELEC. AND MECH. EQUIPMENT

(Continued)

FIGURE E-1, SHEET 1 (ILLUSTRATIVE PURPOSES ONLY)

SATURN V PROGRAM ELEMENTS - CONTINUED

LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
	23 SATURN V FACILITIES	231 LAUNCH VEHICLE FACILITIES	2311 MERRITT ISLAND LAUNCH AREA 2312 MARSHALL SPACE FLIGHT CENTER 2313 MISSISSIPPI TEST OPERATIONS
2 SATURN V SYSTEM	23 SATURN V FACILITIES	232 S-IC FACILITIES	2321 MARSHALL SPACE FLIGHT CENTER 2322 MICHOUD OPERATIONS 2323 MISSISSIPPI TEST OPERATIONS 2324 MERRITT ISLAND LAUNCH AREA 2325 OTHER LOCATIONS
		233 S-II FACILITIES	2331 MARSHALL SPACE FLIGHT CENTER 2332 SEAL BEACH 2333 DOWNEY 2334 SANTA SUZANNA 2335 MISSISSIPPI TEST OPERATIONS
		234 S-IVB FACILITIES	2341 MARSHALL SPACE FLIGHT CENTER 2342 SANTA MONICA 2343 HUNTINGTON BEACH 2344 SACRAMENTO 2345 LONG BEACH 2346 TULSA
		235 INSTRUMENT UNIT FACILITIES	ETC.

FIGURE E-1, SHEET 2 (ILLUSTRATIVE PURPOSES ONLY)

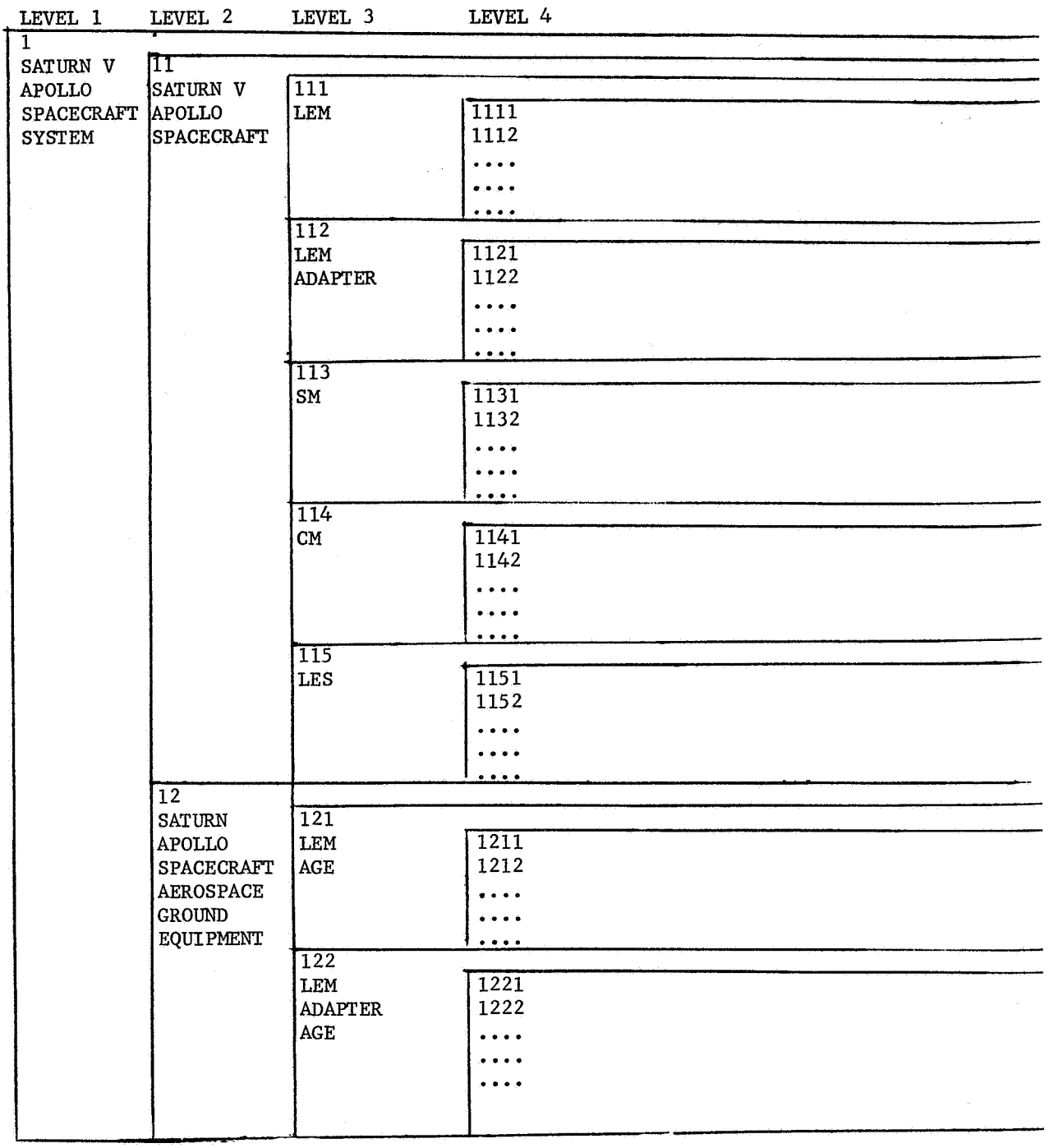

FIGURE E-1, SHEET 3 (ILLUSTRATIVE PURPOSES ONLY)

APPENDIX F

LISTING OF THE NOUN NAME OF COMPONENT PARTS AND THE CORRESPONDING LETTER CODE

The coding table in this appendix is provided to standardize the codes to be used for noun names of component parts, replacement items, and consumables. The codes for the noun names consist of two alphabetical letters and are required for the use in processing logistic loading data using electronic data processing (EDP) techniques. The manner in which they are placed on EDP work sheets is discussed in paragraph 3.3.1.10.

Noun	Code	Noun	Code	Noun	Code
Accumulator	AA	Chopper	CL	Fan	FA
Actuator	AB	Circuit Breaker	CM	Filter	FB
Adapter	AC	Clamp	CN	Filter Element	FC
Alternator	AD	Compressor	CO	Fitting	FD
Ammeter	AE	Computer	CP	Flip-flop	FE
Amplifier	AF	Coil	CQ	Float	FF
Antenna	AG	Conditioner	CR	Flowmeter	FG
Arrestor	AH	Condenser	CS	Fork	FH
Attenuator	AI	Connector	JJ	Frequency Converter	FI
		Contactor	JK	Frequency Meter	FJ
Battery	BA	Control Assembly	JL	Fuel	FK
Bearing	BB	Counter	JM	Fuse	FL
Belt	BC	Coupling	JN		
Bolt	BD	Converter	JO	Gage	GA
Boot	BE	Crankshaft	JP	Gasket	GB
Bulb	BF			Gate	GC
Bumper	BG	Decoder	DA	Gear	GD
Bushing	BH	Diode	DB	Generator	GE
		Disconnect	DC	Grommet	GF
Cable	CA	Discriminator	DD	Handle	HA
Calibration	CB	Dog	DE	Heater	HB
Calibrator	CC	Door	DF	Heat Exchanger	HC
Cam	CD	Drawer	DG	Hinge	HD
Camera	CE	Drier	DH	Holder	HE
Cap	CF	Duct	DI	Hose	HF
Capacitor	CG			Hour Meter	HG
Card	CH	Ejector	EA		
Cartridge	CI	Elbow	EB	Indicator	IA
Chain	CJ	Enclosure	EC	Inductor	IB
Choke	CK	Encoder	ED	Inert Gas	IC

Noun	Code	Noun	Code	Noun	Code
Ink	IH	Oscillator	OC	Relay	RJ
Inlet	ID	Oscilloscope	OD	Resistor	RK
Insulator	IE	Outlet	OE	Resolver	RL
Invertor	IF			Retainer	RM
Isolator	IG	Packing	PA	Ring	RN
		Panel	PB	Rivet	RO
Jackscrew	JA	Paper	PC	Rupture Disc	RP
		Pawl	PD		
Knob	KA	Pilot Light	PE	Screw	SA
		Pin	PF	Seal	SB
Latch	LA	Pipe	PG	Selector	SC
Lamp	LB	Piston	PH	Semiconductor	SD
Lens	LC	Plug	PI	Sensor	SE
Logic	LD	Port	PJ	Servo	SF
LOX	LE	Potentiometer	PK	Shim	SG
		Power Supply	PL	Sleeve	SH
Magnet	MA	Printed Circuit	PM	Socket	SI
Memory	MB	Printer	PN	Solenoid	SJ
Meter	MC	Probe	PO	Solvent	SK
Module	MD	Pulser	PP	Spacer	SL
Monitor Light	ME	Pump	PQ	Spring	SM
Motor	MF			Starter	SN
Mount	MG	Reactor	RA	Strainer	SO
		Receiver	RB	Switch	SP
Network	NA	Receptacle	RC	Synchro	SQ
Nipple	NB	Recorder	RD		
Nozzle	NC	Rectifier	RE	Tank	TA
Nut	ND	Reducer	RF	Tape	TB
		Reflector	RG	Tee	TC
"O" Ring	OA	Register	RH	Telemeter	TD
Orifice	OB	Regulator	RI	Terminal	TE

Thermister	TF
Thermometer	TG
Thermostat	TH
Totalizer	TI
Tube	TJ
Tuner	TK
Transducer	TL
Transformer	TM
Transistor	TN
Transmitter	TO
Transponder	TP
Union	UA
Vacuum Tube	VA
Valve	VB
Vent	VC
Voltmeter	VD
Washer	WA
Wire	WB

APPENDIX G

END ITEM

LOGISTICS REQUIREMENTS SUMMARY

PART I

P.E.N. 5511.08.02

TEST SET ASSEMBLY, CONTROL B-2D

INTERTANK UMBILICAL GROUND CARRIER

Date:

(ILLUSTRATIVE SAMPLE ONLY)

INTRODUCTION

The B-2D Intertank Umbilical Control Test Box supplied by Blank provides manual control of the B-2D Intertank Umbilical Ground Carrier electrical and pneumatic systems by simulating Launch Control Center (LCC) computer control functions. It is used in conjunction with the B-2D Intertank Control Box Assembly, P.E.N. 5514.01.04.

The Test Set is intended for use in the High Bay Checkout of the B-2D Stage, but may be used at any time prior to launch to verify Intertank Umbilical Ground Carrier maintenance.

The August 23, 1965, issue of Volume IX of the Master Equipment Record requires the following B-2 program serial numbered items by location with estimated on dock dates as shown:

Location	
001 SA/UTF	04-01-5A
002 SA/UTF	04-30-5A
003 VAB KSC	08-16-5
004 VAB KSC	11-12-5
005 VAB KSC	12-29-5
006 VAB KSC	01-19-5
007 VAB KSC	03-15-6

1.0 IDENTIFICATION

1.1 PHYSICAL

1.1.1 The B-2D Intertank Umbilical Ground Carrier Test Set Assembly, P.E.N. 5511.08.02 P/N 85-72461-2, is packaged for portability in an aluminum combination ease enclosure (11½ by 14 by 17 inches). The cover is used to store the power and interconnect cable assemblies. The base contains a control and indicator panel and the functional circuitry of the Test Set. The equipment is designed and built by the Blank Company.

1.2 FUNCTIONAL

The Test Set provides manual control of the B-2D Intertank Umbilical Ground Carrier electrical and pneumatic systems by simulating Launch Control Center (LCC) computer control functions. It interfaces with the B-2D Intertank Control Box Assembly, P.E.N. 5511.09.03 P/N 85C80329-2.

1.3 EQUIPMENT USAGE

The Test Set is intended for use in the High Bay checkout of the B-2D but may be used at any time prior to launch to verify Intertank Umbilical Ground Carrier maintenance. The Test Set is required or should be in a stand-by status for the following functions in the AVE operational time flow:

Required: 3197 B-2D Stage Checkout
Requirement Possible: 4972 & 5136, Combined System Test

2.0 LOGISTICS PLAN

2.1 MAINTENANCE POLICY

The B-2D Program Maintenance Policy, Document No. 12M17275, has established the following as the policy for this type of equipment.

2.1.1 First Level Maintenance (In its use location)

(a) Scheduled: No Scheduled First Level Maintenance will be performed on the Test Set.

(b) Unscheduled: If any failure occurs during normal operational use of the Test Set, maintenance will consist of replacement of the complete Test Set.

2.1.2 Second Level Maintenance (In the base shop)

(a) Scheduled maintenance will be performed before each scheduled use of the Test Set. This maintenance will consist of visual check, checkout and calibration.

(b) Unscheduled maintenance will consist of fault isolation, removal and installation of defective subassemblies or components, as well as checkout and calibration of the repaired Test Set Assembly.

2.1.3 Third Level Maintenance (At a remote location)

(a) Scheduled maintenance will consist of major modification of the Test Set which cannot be accomplished by Base Shop(s).

(b) Unscheduled maintenance will include repair, modification and functional checkout of repairable components and major repair of the Test Set Assembly which cannot be accomplished by Base Shop(s).

2.2 MAINTENANCE PLAN

The maintenance plan to support the above policy is defined as follows:

2.2.1 Scheduled Maintenance

(a) The scheduled visual check, functional checkout and calibration must be performed prior to each operational usage of the equipment. These operations must be performed in sequence but may be scheduled at any time

2.2.1 (Cont.)

up to a week before usage since the equipment is not prone to deterioration.

(b) The "Checkout" function specified by the Maintenance Analysis includes both a functional checkout and fault isolation procedure.

2.2.2 Unscheduled Maintenance

(a) First Level, or System Installed Maintenance, will be performed in the VAB High Bay. Maintenance is limited to removal of the malfunctioning Test Set and replacement with an operational unit.

(b) Second Level Maintenance will be performed in the Base Shop Area, where the equipment fault can be determined by performing functional checkout. Faulty components will be removed and replaced. Any checkout required to verify the operation of the replacement component or to verify the installation of a component will be included in the Test Set Operating Manual. Normal repair time - 3.5 manhours.

(c) All personnel task time data shown for installation includes an average time of one hour for obtaining the replacement component. These time requirements may be substantially reduced if replacement components are readily available.

(d) Third level maintenance will include the removal of the internal components from the cabinet with an inspect and repair as necessary function performed on the internal components and the cabinet. Normal repair and refurbishment time - 38.0 manhours. Because of the simplicity of the item it is expected that third level maintenance will not be required.

2.3 SPARES REQUIREMENTS

The Maintenance Analysis process has identified the following as the recommended spares for the initial 12 month support for a population of one Test Set Assembly, P.E.N. 5511.08.02, Part No. 85-72461-2. Second level maintenance only.

	NOMENCLATURE	PART NUMBER	QUANTITY	MAINTENANCE LEVEL
1.	Power Supply	PS 79-438765	1	2
2.	Over Voltage Relay	R-83-4237651-2	1	2
3.	Printed Circuit	11PC14AC13974-37	1	2
4.	Diode	TI7932D835-791	1	2
5.	Indicator	10E13A2C2F1V2R3	1	2
6.	Indicator	10E13A2C2F1V2R4	1	2
7.	Indicator	10E13A2C2F1V2R5	1	2
8.	Indicator	10E13A2C2F1V2R6	1	2
9.	Tellite	111NP2	1	2
10.	On-Off Switch	09SP17359-14	1	2
11.	Trimmer	T73141892	1	2
12.	Relay R-12	218-432-19	1	2
13.	Relay R-13	218-432-20	1	2
14.	Rectifier	T149-R-19654	1	2
15.	Switch Selector	S14-9-3616-219	1	2
16.	Diode	T17932D834-682	1	2
17.	Transitor	T18431T962-412	1	2
18.	Harness	21H-143298-2-21	1	2
19.	Switch Coupler	S21-SW-34198-2	1	2
20.	Printed Circuit	T1-7-PC-2192-16	1	2
21.	Relay R-2	21-8-432-20	1	2
22.	Cable-Power	10E13-A1C1926-1	1	2
23.	Cable-Connector	10E14A2C2114-2	1	2
24.	Capacitor	21E19B1439-151	1	2
25.	Switch-Self Test	SW19325-142	1	2
26.	Relay R-4	218-432-21	1	2
27.	Relay R-5	218-421-43	1	2

2.4 PERSONNEL REQUIREMENTS INFORMATION

One electronic mechanic or technician capable of performing electrical component installation and testing tasks such as calibration and fault isolation will be required to perform First and Second Level Maintenance functions. Skill Code 142. Logistics Loading Code EB.

2.5 AGE/FACILITIES

2.5.1 AGE - The following items of AGE are required for maintenance support of this end item. Stock numbers are not yet available.

EQUIPMENT	USAGE
Voltmeter	Verify power source at test points within the test set.
5 VDC Power Supply	Provide power for Test Set meter calibration.
28 BDC Power Supply	Provide power for Test Set Checkout can calibration.
Test Adapters (Several required to fit various connectors)	Permit rapid checkout of circuits in Test Set and cables; and prevent connector terminal damage caused by probing.
Ohmmeter	Test for continuity and shorts in cables.

2.5.2 Facilities

The following facility items are required for the use and maintenance of this item.

Outlet - 110VAC±10VAC located in the High Bay area, must comply with MIL STD 12345.

Bench, Electronics Repair - To be located in the Electronics Repair Shop, VAB.

2.6 OPERATIONS AND MAINTENANCE INSTRUCTIONS

2.6.1 Operations

Detailed procedures for the pre-use checkout, hookup and use of the Test Set are required. Acceptable and not acceptable values for each test position must be included.

2.6.2 Maintenance

Malfunction isolation and repair procedures for second level maintenance are required. Schematics, part numbers and test procedures must be included.

3.0 SPECIAL LOGISTICS CONSIDERATIONS

There are no critical time requirements or special support considerations associated with the use or repair of this item. There is a problem in the bench test and checkout of the Test Set. This is due to the large number of pins in the cable with the resulting probability of shorting between pins due to the use of meter probes and jumper wires. It is recommended that a test adapter be provided to increase the ease of trouble shooting and eliminate the possibility of shorting between pins.

APPENDIX G

END ITEM

LOGISTICS REQUIREMENTS SUMMARY

PART II

P.E.N. 5511.08.02

TEST SET ASSEMBLY, CONTROL B-2D

INTERTANK UMBILICAL GROUND CARRIER

Date:

(ILLUSTRATIVE SAMPLE ONLY)

FOREWORD

Part II, when combined with Part I comprises the complete End Item Logistics Requirement Summary for this Test Set.

Part II elevates the single item requirements of Part I to that level necessary to support the contractors system for a single launch cycle.

Where management action is considered desirable, recommendations for such action are included.

This report will be updated as new or additional information becomes available.

INDEX

1.0 Logistics Loading

2.0 Spares

3.0 Personnel

4.0 Training

5.0 Operations and Maintenance Instructions

6.0 Maintenance Ground Equipment

7.0 Conclusions

8.0 Recommendations

9.0 Supporting Documentation

END ITEM LOGISTICS REQUIREMENTS SUMMARY - PART II

P.E.N. 5511.08.02 Date:

TEST SET ASSEMBLY, CONTROL, B-2D INTERTANK UMBILICAL GROUND CARRIER

1.0 LOGISTICS LOADING

1.1 This Test Set is scheduled to be used for a 2.25 hour period during the performance of sequence No. 3197 B-2D Stage Check-out and an equal amount of time (as a minimum) in the event of a malfunction in the umbilical system during the performance of sequence number 4972 or 5136, combined System Test.

1.2 The skills necessary for the operation of this Test Set will be required in the area for related purposes and will be available for the operation of this Test Set. No new personnel are needed for the operation of this Test Set. It is recommended that the skill code 142, available for other purposes, be trained in the use of this Test Set.

1.3 The skills necessary for the second level maintenance are new requirements. This support function will require approximately .02% of their available time. It is recommended that the skills identified for maintenance be procured initially against this item with a 98% availability of time for application against items yet to be identified.

1.4 The conclusions reached above are the result of manual loading analysis and do not reflect timed flow simulation findings or concurrent AVE Operations Flow. It is concluded, however, that one Test Set Assembly is adequate to support one launch sequence and in the event of failure a replacement set will be available. It is also concluded that the personnel identified are adequate.

END ITEM LOGISTICS REQUIREMENTS SUMMARY - PART II

P.E.N. 5511.08.02 Date:

TEST SET ASSEMBLY, CONTROL, B-2D INTERTANK UMBILICAL GROUND CARRIER

2.0 SPARES

2.1 The initial Spare Parts List presented in Part I has been upgraded from the population of one concept to the list, No. MS-D2-136-65, discussed below. The upgrading process included:

a. The support of seven end items rather than one.

b. The application of conventional provisioning techniques in addition to the maintenance analysis findings.

c. The application of the failure rates determined appropriate for each part and reported on the Maintenance Activities Analysis Form.

Final quantities determination for site loading will evolve via the Logistics Loading and will be reported in the Site Logistics Requirements Summary. The original list was reviewed by the Umbilical Test Laboratory on May 3, 1965, and the following items were deleted.

PART NUMBER	NOMENCLATURE	QUANTITY
10E14A1C2F1J3N1R1	Indicator	2
10E14A1C2F135J3L(GGWW)N2R1	Indicator	4
10E14A1C2J3L(WWGG)N2R1	Indicator	2
10E14A1C2J3L(GGWW)N2R1	Indicator	2
101NG	Tellite	2

Of the remaining 22 items, 16 are defined as logical spares with six as additional insurance items.

2.2 A Spare Parts Change List, No. 1A, was submitted May 3, 1965, reflecting a revision of part number AM12-150DC5 to part number 218-421-43.

2.3 The spares recommended for procurement are considered sufficient to support seven end items for a period of 12 months. The Spares Master File has been searched and there are new items. Spares replenishment will be in accordance with the requirements of the LVGSE Logistics Implementation Plan. The end items of hardware are to be distributed as follows:

001 and 002 SA/UTF
003 through 007 VAB KSC

2.4 It is recommended that the supporting spares for 001 and 002 be placed in the Supply Support Warehouse at MSFC; and that the supporting spares for 003 through 007 be shipped to KSC for storage and issue.

2.5 The Approved Spares List No. MS-D2-136-65, were placed on order on April 29, 1965, (Purchase Order No. MSFC-4-65S) with the first delivery scheduled June 12, 1965. Because of packaging problems this date was changed to July 16, 1965.

END ITEM LOGISTICS REQUIREMENTS SUMMARY - PART II

P.E.N. 5511.08.02 Date:

TEST SET ASSEMBLY, CONTROL, B-2D INTERTANK UMBILICAL GROUND CARRIER

3.0 PERSONNEL

3.1 The Support Personnel Requirements as identified in the maintenance analysis for this item have been reviewed with the following conclusions:

a. The personnel skills required to support this item have been identified in sufficient quantities to support end items 003 through 007 at KSC.

b. The personnel team required to provide maintenance support for this item consists of a one man team, skill code 142, Elec. Power System.

The task proficiency of the Electrical Power System personnel shall be 121 - 1 perceptual - low demand
2 judgmental - medium demand
1 motor - low demand

c. The EDP Personnel File has been updated to include this skill with a 2% employment factor - training is required.

3.2 The Operating Personnel requirements were extracted from the AVE Requirements Analysis sheets for sequence Nos. 3197, 4972 and 5136. The sequences require the presence of two skill codes 142. Elec. Power System, to operate other equipment provided by the Blank Company. Their employment time for this additional equipment is 68% of their available 8 hours. The operation of this Test Set Assembly is assigned to these personnel and the EDP personnel file has been updated accordingly. This new assignment brings the employment to 90.1% for this person in support of sequence 3197. Training will be required.

END ITEM LOGISTICS REQUIREMENTS SUMMARY - PART II

P.E.N. 5511.08.02 Date:

TEST SET ASSEMBLY, CONTROL, B-2D INTERTANK UMBILICAL GROUND CARRIER

4.0 TRAINING

4.1 A Training Plan for this item is not on contract. Present contractual coverage should be modified to require the contractor to develop necessary training on this item. This recommendation is based on the following:

a. Training requirements exist on this item to support second level maintenance and operational use.

b. Personnel training on this item is not included in existing training courses.

c. Training course development is not contractually required of the contractor.

END ITEM LOGISTICS REQUIREMENTS SUMMARY - PART II

P.E.N. 5511.08.02 Date:

TEST SET ASSEMBLY, CONTROL, B-2D INTERTANK UMBILICAL GROUND CARRIER

5.0 OPERATIONS AND MAINTENANCE INSTRUCTIONS

5.1 INSTRUCTIONS IDENTIFYING NUMBER-MSFC-XXY

These instructions reflect the initial release of the Maintenance Analysis for the Test Set and the AVE Operations Flow.

Instructions for the pre-use checkout, hook-up and use of the Test Set are included under Operations.

Instructions for second and third level maintenance, with the necessary schematics, malfunction isolation procedures, check and test procedures and spares are included under maintenance. Third level maintenance is confined to complete refurbishment or modification.

END ITEM LOGISTICS REQUIREMENTS SUMMARY - PART II

P.E.N. 5511.08.02 Date:

TEST SET ASSEMBLY, CONTROL, B-2D INTERTANK UMBILICAL GROUND CARRIER

6.0 MAINTENANCE GROUND EQUIPMENT

6.1 Action taken relative to AGE recommended in Part I, Paragraph 4.3 is as follows:

a. The voltmeter and ohmmeter requirements can be satisfied by Federal Stock Number 6625-149-6301 Volt-Ohm-Milliammeter. This item has been submitted on a Standard Equipment Requirement form in accord with D5-16000-590, Section 6.

b. The 5VDC Power Supply Requirement and the 28VDC Power Supply Requirement can be satisfied by an FSC6130 5VDC Power Supply. A Standard Equipment Requirements Form for this item is in process.

c. EIC No. 1003 has been submitted and approved by the Systems Engineering Review Board for a set of test adapters as required by Paragraph 4.3 of Part I.

END ITEM LOGISTICS REQUIREMENTS SUMMARY - PART II

P.E.N. 5511.08.02 Date:

TEST SET ASSEMBLY, CONTROL, B-2D INTERTANK UMBILICAL GROUND CARRIER

7.0 CONCLUSIONS

7.1 SPARES

a. That no spare end items, complete, were provisioned and none are recommended.

b. That all spare parts provisioned are to support second level maintenance only. No third level maintenance was anticipated.

7.2 PERSONNEL

The skills necessary for the operation and maintenance of this Test Set are presently available in the operational area and the addition of this Test Set to their work load will not exceed their 8.0 hour day.

The skills necessary for the maintenance of the Test Set have not been identified for other purposes and it is therefore not yet scheduled to be placed in the shop.

7.3 TRAINING

Training requirements for the operation and maintenance of this equipment have not been developed. If training is not provided, then the operations and maintenance personnel must learn the equipment from the operations and maintenance instructions during the operations and maintenance procedure.

7.4 TECHNICAL SUPPORT DATA

This manual will provide the primary guidance during the use and maintenance of the Test Set. However, the manual has not been verified or validated. The updating change in process will not be validated.

7.5 LOGISTICS LOADING

The frequency of the use of this Test Set cannot be determined until the assignment of OGE to launch sequences is completed and simulation studies run for single and concurrent vehicle processing. Spares quantities information will be supplied at that time.

7.6 MAINTENANCE GROUND EQUIPMENT

This paragraph presupposes the existence of soldering equipment and common tools in the shop at KSC. It also presupposes the absence of the volt-ohmmeter and the power supplies. This situation could result in not having the common hand tools and/or duplicating the volt-ohmmeter and power supplies.

8.0 RECOMMENDATIONS

8.1 SPARES

The spares identified should be procured and distributed as indicated, with replenishment ordering based on the findings of the Simulation Studies and Live Logistics Loading.

8.2 PERSONNEL

That the operational use of this Test Set be assigned to the personnel responsible for the performance of Activity 3197. It is also recommended that one skill code 142 be provided the electronic support shop.

8.3 TRAINING

That the two 142 skills presently assigned to support activity 3197 be trained in the use of this Test Set. That the 142 skill assigned to the Electronic Repair Shop be trained in the repair of this item.

8.4 TECHNICAL SUPPORT DATA

The operations and maintenance instructions, as presented, should be procured. However, 11-6141 Contract, should be revised to include a verification and validation program for the Support Data.

8.5 LOGISTICS LOADING

That Logistics Loading track the unassigned time of the operation and maintenance skills for the addition of other tasks until fully employed.

8.6 MAINTENANCE GROUND EQUIPMENT

Each contractor performing Maintenance Analysis should be provided a list of the common tools and equipment which will be available in the KSC shops. Further, that the SE & IS Contractor, via Logistics Loading, makes final determination as to the need to procure additional tools and equipment.

8.7 NOMENCLATURE

To provide uniformity in identification, the nomenclature, as given in the Master Equipment Record, together with the Program Element Number, should be used as the correct nomenclature for the AGE hardware.

Date:
LSAGE-43-12

To: The Manager, B-2 AGE Logistics

From: The Director, Logistics

Subject: AGE Inventory Search

Reference: Memo LVAGE 43-5, dated August 25, 1965

1. The available inventory has been searched with the following findings:

   a. Volt-Ohm-Milliammeter, SN 6625-149-6301. There are four of these items in use in the MSFC Electronics Laboratory. The quantity available at KSC is not monitored by this office.

   b. Power Supply FSC6130. This item is not presently in inventory.

2. As both items are standard, it is recommended that they be procured, in the quantities required to support the program.

John Doe, Director
Logistics

JD/jc

Date:
LSAGE-43-5

To: The Director, Logistics

From: The Manager, B-2 AGE Logistics

Subject: LVAGE Implementation Plan, Paragraph 6.3

1. The Maintenance Ground Equipment listed below has been identified by the Blank Contractor as required to support the Test Set Assembly Control, B-2D Intertank Umbilical Ground Carrier, P.E.N. 5511.08.02.

2. Prior to initiating procurement action on these items it is requested that the AGE inventory be searched for these items.

3. If the items are in inventory, their quantities and availability dates are requested.

4. The items are defined as follows:

   a. The voltmeter and ohmmeter requirements can be satisfied by Federal Stock Number 6625-149-6301 Volt-Ohm-Milliammeter. This item has been submitted on a Standard Equipment Requirement form in accord with D5-16000-590, Section 6.

   b. The 5VDC Power Supply Requirement and the 28VDC Power Supply Requirement can be satisfied by an FSC6130 5VDC Power Supply. A Standard Equipment Requirements Form for this item is in process.

Jim Jones, Manager
B-2 AGE Logistics

JJ/jc

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